FINAL REPORT

Innovative Technology Development for Comprehensive Air Quality Characterization from Soil-Covered Open Detonation of Military Munitions

SERDP Project WP-2233

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14. ABSTRACT

Emissions from open burning and open detonation (OB/OD) of military ordnance were sampled using a novel, aerostat-lofted sampler (termed the "Flyer"). Air emissions from OB/OD operations have been very difficult to characterize because of rapid plume dispersion, the short duration of the event, the heterogeneous emission concentrations, large plume lift, soil entrainment, and explosive safety restrictions. With a criterion of elevated CO_2, 71% of the 109 detonations were successfully sampled from June 11 to June 27, 2012 at Tooele Army Depot, UT. Bulk energetics and cased munitions, including Comp B, V453, and V548 munitions, were detonated without soil cover (only Comp B) or at soil cover depths of 3 ft (1 m) and 6 ft (2 m). Emissions were characterized for determination of PM by size, CO_2, VOCs, energetics, and metals. This work is the first ever open air sampling of emissions from representative detonation trials of cased munitions and the first determination of $PM_{2.5}$ emission factors for OD. Energetic emissions were typically less than 1/100,000 of that in the original munition by mass. Limited evidence suggests that soil-covered detonations may have higher energetics release than surface detonations. Energetic emissions seem to be munition-specific as V548 released about 30 times that of the other munitions. Continuous particle size measurements show that 59% of the PM mass in the plume is less than $PM_{2.5}$ and the total PM is much greater than that from the ordnance alone, as the plume contains large quantities of soil particles, especially for covered detonations. The fate of metals in the emissions is metal- and ordnance-type-specific. Overall testing found that less than 1% of the zirconium and 22% of the hafnium found in the munition was detected in the plume.

15. SUBJECT TERMS
Open Detonation, soil-covered, OB/OD, Air quality characterization, Emission factor, Aerial measurement, RCRA Subpart X, Particulate matter (PM), $PM_{2.5}$, PM_{10}, Energetics

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Abstract

Emissions from open burning and open detonation (OB/OD) of military ordnance were sampled using a novel aerostat-lofted instrument (termed the “Flyer”). Air emissions from OB/OD operations have been very difficult to characterize because of rapid plume dispersion, the short duration of the event, the heterogeneous emission concentrations, large plume lift, soil entrainment, and explosive safety restrictions. A 16 ft (4.9 m) helium-filled aerostat/Flyer was maneuvered into the plumes by two tethers connected to two remotely controlled winches mounted on all-terrain vehicles. With a criterion of CO_2 elevated above ambient concentration, 71% of the 109 detonations were successfully sampled over a three week period from June 11 to June 27, 2012 at Tooele Army Depot, UT. Bulk energetics and cased munitions, including Comp B, V453, and V548 munitions, were variously detonated on the surface or at soil cover depths of 3 ft (1 m) and 6 ft (2 m). Emissions were characterized for determination of particulate matter (PM) by size, CO_2, volatile organic compounds (VOCs), energetics, and metals. This work is the first emission sampling of soil-covered metal-cased ordnance detonations in the open atmosphere and determined the first $PM_{2.5}$ emission data for OD operations.

A total of 13 open burns were conducted on two ammonium perchlorate based propellants for measurement of HCl, perchlorate, and chlorate species. Simultaneous measurements of CO_2 concentration and aerostat/Flyer position were made to compare against predictions from the Open Burn/Open Detonation Dispersion Model (OBODM).

Energetic emissions were typically less than 1/100,000 of that in the original munition by mass. Limited evidence suggests that soil-covered detonations have higher energetics release than do surface detonations. Emissions, however, seem to be munition-specific as V548 released about 30 times that of the other munitions. Continuous particle size measurements show that 59% of the PM mass in the plume is less than PM with particles 2.5 µm in diameter or smaller ($PM_{2.5}$) and the total PM mass is much greater than that from the ordnance alone, as the plume contains large quantities of soil particles. The fate of metals in the emissions is metal- and ordnance-type-specific. Less than 1% of zirconium and 22% of hafnium, metals found in the munition and not typically in the soil, were found in the plume.

This work, SERDP project WP-2233, is a continuation of Strategic Environmental Research and Development Program (SERDP) project WP-1672 “Feasibility of New Technology to Comprehensively Characterize Air Emissions from Full Scale Open Burning and Open Detonation” and WP-2153 “Innovative Technology Development for Comprehensive Air Quality Characterization from Open Burning”, which were successfully completed in FY10 and FY12, respectively.

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List of Acronyms

Term	Definition
AD	Absolute difference
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AMCCOM	U.S. Army Armament, Munitions and Chemical Command
AP	ammonium perchlorate
AP-42	Environmental Protection Agency's Compilation of Air Pollutant Emission Factors
ATV	all terrain vehicle
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAS	Columbia Analytical Services
CEM	continuous emissions monitor
CFR	Code of Federal Regulations
DAC	U.S. Army Defense Ammunition Center
DoD	Department of Defense
DODIC	DoD Identification Code
DNA	does not apply
DNT	2,4-Dinitrotoluene
DPG	Dugway Proving Ground, UT
EF	emission factor
FID	flame ionization detector
GC/MS	gas chromatography/mass spectroscopy
GPS	global positioning system
GWT	gross weight
HAP	hazardous air pollutant
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
ICP	inductively coupled plasma
ISO	International Organization for Standardization
JMC	U.S. Army Joint Munitions Command
LCMS	liquid chromatography-mass spectrometry
LIDAR	light detection and ranging
MCE	mixed cellulose ester
MPL	micro pulse LIDAR
MRL	method reporting limit
N	number of samples
NA	not analyzed
NEW	net explosive weight
ND	not detected
NDIR	nondispersive infrared
NIOSH	National Institute of Safety and Health
NS	not sampled
OB	open burning
OBODM	Open Burn/Open Detonation Dispersion Model

Term	Definition
OD	open detonation
ORS	optical remote sensing
OP-FTIR	open path Fourier transform infrared spectrometer
PCF	Photometric calibration factor
PETN	pentaerythritol tetranitrate
PM	particulate matter
PM_x	particulate matter that is “x” micrometers or smaller in aerodynamic diameter
PUF	polyurethane foam
QAPP	quality assurance project plan
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RCRA	Resource Conservation and Recovery Act
RPD	regression point displacement
RSD	relative standard deviation
SERDP	Strategic Environmental Research and Development Program
SVOC	semivolatile organic compound
STDV	standard deviation
TEOM	tapered element oscillating microbalance
Tetryl	2, 4, 6, trinitrophenylmethyinitramine
TNT	2,4,6-trinitrotoluene
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
XRF	X-ray fluorescence

1. Introduction

1.1 Project Overview

U.S. Department of Defense (DoD) Installations, especially demilitarization facilities and Army Ammunition Plants, have long used Open Burning/Open Detonation (OB/OD) as a safe, effective, and economic means to dispose of propellants, explosives, and waste military munitions. DoD installations are required to comply with the Resource Conservation and Recovery Act (RCRA) to operate OB/OD facilities. RCRA permits provide annual limits on the amount of energetic materials that can be disposed of at OB/OD facilities. The permit limitations are based on human health risk assessments that include evaluation of risks from airborne exposure to emissions generated from OB/OD. These assessments have used emission factors developed from limited open atmosphere testing as well as from a small-scale OB/OD chamber known as a BangBox®. These chamber studies have limitations, primarily related to questions of representativeness. Open air, full-scale field OB/OD air emissions determinations resolve questions of representativeness but these air emission characterizations are very difficult because of rapid plume dispersion, short event duration, heterogeneous emission concentrations, large plume lift, soil entrainment, and explosive safety restrictions. Results from improved methods and equipment for conducting open atmosphere air emissions testing for OB/OD will confirm a capability for determining representative air emission factors, validate current emission factors, and produce high quality emission factors that address known data gaps.

The Strategic Environmental Research and Development Program (SERDP) supported a research program to develop field measurement technology for OB/OD emissions that consisted of three one-year projects. Work on SERDP project WP-2233 is a continuation of work on SERDP projects WP-2153 “Innovative Technology Development for Comprehensive Air Quality Characterization from Open Burning” (Kim et. al, 2010) and WP-1672 “Feasibility of New Technology to Comprehensively Characterize Air Emissions from Full Scale Open Burning and Open Detonation” (Kim et. al, 2012). For each project, the research team developed field campaign plans and conducted three to four week field campaigns at Tooele Army Depot, Utah, in March 2010 (WP-1672), April 2011 (WP-2153), and June 2012 (WP-2233). Under WP-1672, the team conducted feasibility studies to test both in situ and optical remote sensing (ORS) emission measurement technologies for OB of M1 propellant and OD of 2,4,6-trinitrotoluene (TNT). The feasibility tests showed that both an in situ, balloon-lofted sampler known as the “Flyer” and an ORS method for particulate matter (PM) measurements showed promise. Because the Flyer was capable of additional measurements as well as PM, it was chosen as the measurement technology for the remaining emission measurement studies.

Work on WP-2153 included OB emissions characterization of several propellants using the Flyer and work on WP-2233 focused on characterizing emissions from soil-covered OD. Close coordination with the DoD demilitarization community enabled the research team to determine the feasibility of emission measurement systems, develop the capability to characterize air emissions from full-scale OB/OD operations, and generate accurate munitions disposal emission factors.

These emission factors will enable OB/OD facilities to calculate their mass emissions and operate at levels that comply with environmental regulations and protect human health and the environment.

1.2 Objectives

The objectives of WP-2233 were to:

1. Develop and demonstrate innovative methods capable of sampling air emission from soil-covered detonations of metal-cased munitions and bulk energetics;
2. Conduct a field campaign to measure emissions of CO_2, CO, total PM, particles 10 µm in diameter or smaller (PM_{10}), particles 2.5 µm in diameter or smaller ($PM_{2.5}$), metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) that are energetics;
3. Develop capability to calculate and compile soil-covered OD emission factor data; and
4. Identify and determine the effect of parameters potentially impacting emissions of concern.

This project also included secondary objectives to measure emissions of CO_2, CO, PM_{10}, $PM_{2.5}$, total PM, metals, and VOCs from OB of propellants containing ammonium perchlorate (AP).

1.3 Background

1.3.1 Previous OB/OD Emission Work

Between 1961 and 1981, Ornellas conducted a series of bomb calorimeter detonation experiments designed to determine how various factors influenced the efficiency and effectiveness of the detonation process (Ornellas, 1982). His experiments established that the major reaction products from an unconfined detonation were N_2, CO_2, and H_2O, and the minor products were CO, H_2, CH_4, NO, NO_2, HCN, HCl, HF, and VOCs.

The first comprehensive DoD study to characterize the air emissions from real-world open burning and detonation operations was conducted at Dugway Proving Ground (DPG), UT from 1984 through 1986. The results were inconclusive (U.S. Army, 1988).

In 1989 - 1990, the United States Army conducted a highly successful follow-on study (U.S. Army, AMMCOM, 1992[a-f]). The first stage of this follow-on study involved detonating 0.5 lb quantities of TNT and open burning 5-lb quantities of a double-base and a composite propellant in a 32,900 ft3 hemispherical chamber (BangBox®) at Sandia National Laboratories in Albuquerque, NM. A suite of state-of-the art sampling systems was then used to characterize the identities and quantities of the pollutants present in the plumes. The results from these burns and detonations were used to select the plume sampling equipment subsequently used to measure chemicals of environmental concern in the plumes produced when large quantities of energetic materi-

als were detonated and burned on an open test range at DPG. The sampling equipment selected was installed in a twin-engine, turboprop aircraft and the aircraft was used to sample the plumes released when 2,000 lb of high explosives were detonated and when 5,000 to 7,000 lb of propellants were open burned in steel pans at DPG.

Based on the test results, DoD concluded that the emission factors for the predominant pollutants produced in the BangBox® emissions tests were statistically equivalent to those produced in the DPG open range tests and those produced in Ornellas' bomb calorimeter experiments. That is, the pollutants did not change substantially even when the quantity of energetic material detonated increased by a factor of 32,000.

In 1992, the U.S. Environmental Protection Agency (USEPA) concurred with DoD's conclusions and agreed to accept BangBox®-produced emission factors as representative of those that would be derived through ground level, open-air detonation and burn tests. The U.S. Army then installed a BangBox® at DPG and conducted a series of studies that characterized the air emissions produced when bulk and cased high explosives were detonated and bulk propellants were burned (Mitchell and Suggs, 1998). These studies were then followed by larger scale detonation and burn experiments in a larger chamber at the Nevada Test Site that involved detonating 155MM projectiles and burning Hawk and NIKE rocket motors. All of these studies employed plume sampling and analysis systems that were similar to those used in the earlier DPG open range studies, but also had a larger list of target emission products (analytes). These follow-on studies filled in some of the major data gaps left by the open range studies and reconfirmed the conclusions of Ornellas and the DPG open range tests.

Work by Lindsay et. al, 2000 employed blimp sampling at Hill Air Force Base in 1998 and 1999 to characterize emissions from OD. The emissions were sampled via canisters, silica tubes, and Teflon filters suspended from the blimp for CO_2, VOCs, chloride analyses, and particulate matter. These tests were partially successful and showed the potential for aerial sampling platforms.

In 2008, DoD began working with USEPA to submit the compilation of OB/OD emission factors (EFs) from these emission characterization studies, following USEPA procedures and requirements, to USEPA for placement in the USEPA Compilation of Air Pollutant Emission Factors (AP-42) database of EFs. In coordination with USEPA, DoD developed the AP-42 Draft Chapter 16 - Emission Factors for OB/OD Demilitarization Processes. The AP-42 Draft Chapter 16 was first compiled and submitted to USEPA in 2009 after an extensive review by organizations in every branch of DoD. Continued coordination with USEPA enabled DoD to perform required formatting and technical revisions to the Draft Chapter 16. With these amendments, the Draft Chapter 16 was prepared for publication in AP-42, however DoD and USEPA determined that it would be more beneficial to wait and incorporate the ongoing SERDP OB/OD air emission characterization efforts. Upon completion, DoD review, and publication of the SERDP WP-1672 and WP-2153 testing events, USEPA reviewed the SERDP final reports and the information and data were incorporated into the current Draft Chapter 16 (AP-42, 2011). The final version of the Draft

Chapter 16 for publication in USEPA's AP-42 database is nearly complete and submittal to USEPA is expected to occur within 4 months of publishing this report.

At the start of the SERDP-sponsored OB/OD work, the draft Chapter 16 of AP-42 contained tables showing emission factors and emission factor quality ratings for both OB and OD operations. The USEPA quality rating codes for the emission factors range from A (excellent) to D (below average). A large majority of emission factors were rated C or better. Emission factors with a D rating included PM_{10} from OD and metals from OD. The proposed draft Chapter 16 had no emission factors for $PM_{2.5}$ or any emission factor data for soil-covered OD. The updated Chapter 16 will include some emission factors improvements based on results from WP-1672 and WP-2153 which are discussed in the next two sections.

1.3.2 Summary of WP-1672

WP-1672 consisted of in situ and ORS sampling, analysis, and monitoring (Kim et. al, 2010). The final technical report is available at the SERDP/ESTCP web site (http://www.serdp.org/content/download/9560/122378/file/WP-1672-FR.pdf). The in situ sampling configuration included fixed position samplers and airborne sampling. The aerial platform used a balloon-lofted instrument package called the "Flyer." The instrument pack was lofted with a Helium-filled balloon and maneuvered by two tethers connected to two all-terrain-vehicles (ATVs). Continuous measurements of CO_2 and co-sampled PM_{10}, VOCs, and SVOCs allowed the determination of emission factors through a carbon mass balance method.

The ORS monitoring consisted of a system for (1) gases and a system for (2) PM that included: 1) active and passive open-path Fourier Transform Infrared spectrometers (OP-FTIR) and Ultraviolet Differential Optical Absorption Spectrometers (UV-DOAS), and 2) a hybrid-ORS that includes Micropulse LIght Detection And Ranging (LIDAR) (MPL) and in situ point measurements. The hybrid-ORS system was complemented with two Tapered Elemental Oscillating Microbalances (TEOMs) and anemometers. The hybrid-ORS system measured light extinction values with the MPL and real time PM_{10} concentrations with the TEOMs. The MPL was mounted on a positioner to scan "slices" of the plume in vertical directions. The TEOMs were placed on a scissors lift and raised about 30 feet off the ground. Wind speed and wind direction, the duration of each event, and the mass of energetic that was detonated or burned for each event were then used to determine gas and PM_{10} mass emission factors for OB and OD sources.

Both in situ and ORS measurements have strengths and weaknesses in terms of their abilities to effectively sample or detect representative emissions in OB/OD plumes. The methods evaluated in WP-1672 were designed to complement each other. During the field campaign, we experienced a wide range of weather conditions typical of Tooele Army Depot in March including rapid and drastic changes in wind direction and speed, strong solar radiation, and precipitation. The changing and unpredictable wind conditions were challenging and each measurement system was most effective under different conditions:

- Aerial sampling by the tethered balloon was very effective during both low and high wind speeds. The mobility provided by the ATV arrangement and the use of highly trained aviation experts enhanced the sampling effectiveness.
- The MPL was effective under most conditions due to its ability to scan through complete vertical slices of the passing OB and OD plumes. Higher wind speeds limited the number of complete scans the MPL could make through individual plumes.
- Ground-based ORS and TEOM plume detection and sampling effectiveness was enhanced at high wind speeds which held the plume close to the surface and greatly reduced at low wind speeds where thermal diffusion resulted in rapidly rising plumes with limited horizontal transport.

For the surface OD of TNT, the PM_{10} emission factor derived from Flyer measurements was 0.13 lb/lb net explosive weight (NEW), the emission factor derived from the ORS-based PM measurement method was 0.20 lb/lb NEW, and the draft emission factor is 7.2 lb/lb NEW (AP-42, 2011). Although the ORS-based PM measurement method emission factor was almost twice that of the Flyer derived value, the two values were still remarkably close considering the fundamental difference in the two measurement systems. The draft AP-42 value is much higher indicating the potential importance of local conditions on the amount of soil PM that can be entrained in an OD plume.

For the OB of M1 propellant, the PM_{10} emission factor derived from Flyer measurements was 5.7E-03 lb/lb NEW, the emission factor derived from the ORS-based PM measurement method was 6.5E-03 lb/lb NEW, and the draft emission factor was 6.9E-03 lb/lb NEW (AP-42, 2011). This close agreement is strong evidence that both PM measurement systems used in the field campaign worked well for OB PM_{10} emissions. Although both PM measurement systems had success during the Tooele field campaign, the Flyer-based system was in general more flexible during all wind conditions and was chosen as the measurement system to characterize OB PM emissions for WP-2153.

The emission factors for the two target gases (i.e., benzene and naphthalene) derived from Flyer measurements of OB and OD were quite close to draft values (AP-42, 2011). The Flyer was also able to measure other polycyclic aromatic hydrocarbons and these emission factors were again comparable to draft values when they were available (AP-42, 2011). These results and the proven capability of using the balloon to place the Flyer in the plume are strong indicators of the Flyer measurement system's capability to accurately assess both volatile and semivolatile organic gas emissions.

In contrast, the ORS measurement systems were not able to detect the target gases and therefore no comparison could be made between the two types of gas measurement systems. The OP-FTIR was able to consistently detect CO and sporadically detect NO, NO_2 ethylene, ammonia, and acetylene. The OP-FTIR was able to measure CO_2 for most OB events but the correlation between CO and CO_2 was very poor. For OD, very few of the plumes where CO was detected also

had a corresponding CO_2 detection. The emission factors derived from OP-FTIR measurements for CO were 8.1E-03 lb CO/lb NEW for OB and 6.0E-02 lb CO/lb NEW for OD. This corresponds to 2.2 E-02 lb CO/lb C for OB and 1.6E-01 lb CO/lb C for OD and the draft AP-42 values for CO emission factors were 8.2E-04E-04 lb CO/lb C for OB and 1.5E-01 lb CO/lb C for OD (AP-42, 2011). The OD CO emission factor derived from the OP-FTIR measurements is very close to the draft AP-42 value while the OB CO emission factor is not. The UV DOAS detected NO in OB and OD plumes but provided no additional information when compared to the OP-FTIR data. The two passive FTIRs did provide results for some plumes but the results were often contradictory and the information provided no additional benefits beyond what we achieved with OP-FTIR. In general, the ORS monitoring for gasses produced poor or inconsistent results and the research team decided not to continue this type of monitoring for the SERDP sponsored OB/OD emission measurement technology development work.

1.3.3 Summary of WP-2153

WP-2153's objectives included developing field scale air emission measurement technology for OB munition demilitarization operations and compiling emission factor data for the propellants tested during the project's field campaign (Kim et. al, 2012). The final technical report is available at the SERDP/ESTCP web site (http://serdp-estcp.org/content/download/15568/177130/file/WP-2153-FR.pdf). Emission measurements and samples were collected using the balloon-lofted instrument package called the "Flyer." The instrument pack was lofted with a Helium-filled balloon and maneuvered by two tethers connected to two ATVs. Flyer measurements and analysis of samples collected by the Flyer allowed the determination of emission factors through a carbon mass balance method.

In order to meet the objectives of WP-2153, we conducted a field campaign to characterize air emissions from OB in pans of three propellants (M31A1E1, M26 and SPCF) and static firing of Sparrow rocket motors (containing AP composite propellant). The field campaign occurred over a three week period from March 19 through April 7, 2011 at Tooele Army Depot, UT. The research team also evaluated the feasibility of using the Flyer to characterize air emissions from soil-covered OD.

During the field campaign, the Flyer was maneuvered into the OB and static fire plumes for sampling. The 46 lb [21 kg] instrument package was lofted with a He-filled balloon of 16 ft [4.9 m] nominal diameter, maneuvered by two tethers connected to two vehicles. Continuous measurements of CO_2 and CO, and batch samples for particulate matter (PM_{10} and $PM_{2.5}$), metals, HCl, perchlorate, chlorate, VOCs, and SVOCs allowed determination of emission factors. CO_2 readings indicated that the Flyer was successfully maneuvered into 90-98% of the OB plumes from pan burning of the three different propellant types and 92% of the static firing plumes.

The resulting emission factors for PM_{10} and $PM_{2.5}$ were very close, suggesting that OB plumes generate mostly fine PM ($PM_{2.5}$). The calculated emission factors were compared to the first year results and literature values for similar propellant types. The derived emission factors for Pb and

Ba from SPCF and M26, respectively, were in the same range as the Pb emission factor from the first year study of M1 propellant (WP-1672). For the Sparrow rockets, the PM_{10} emission factor for Al accounted for 16% of the Al contained in the munition. HCl was measured from the Sparrow rocket motor OB plumes with two different sampling methods, each resulting in comparable emission factors. The derived HCl emission factor was approximately ten times lower than found in the literature. Chlorate was also detected but was very close to the method reporting limit. No perchlorate and CO were detected for any of the propellants. Very low levels of these emissions are expected with complete combustion of propellants.

2. Materials and Methods

Prior to the field campaign at Tooele Army Depot, the USEPA sampling group developed a Quality Assurance Project Plan (QAPP) Addendum to previous years' work that described the munitions to be tested, the test range, testing procedures, sampling methods, analytical methods, and emission factor development. The QAPP Addendums for WP-2233 are additions to the original QAPP and addendums developed for WP-2153. The original QAPP is attached in Appendix A, the QAPP covering work during WP-2153 in Appendix B, the Cl species test methods QAPP in Appendix C, the QAPP for work during WP-2233 in Appendix D, and a QAPP covering methods for comparing Open Burn/Open Detonation Dispersion Model (OBODM) results to Flyer results in Appendix E. Each QAPP was approved by the advisory group before each of the field campaigns. Appendix H contains chain of custody documents for all samples and Appendix I contains certificates of analysis for calibration gasses.

2.1 Munitions and AP-Based Propellants

Three munitions (Comp B, V453, V548), and two AP-based Arcadene propellants (ARC 451, ARC 452A) were tested during OD and OB trials, respectively (Figure 2-1 and Figure 2-2). These munitions and their composition, and relevant elemental composition of the metal casings are shown in Figure 2-3 and Figure 2-4. The composition of the munitions, donor charges, and ARC propellant are listed in Table 2-1. All munitions were selected and ranked in priority by the Joint Munitions Command (JMC) for this work based on ammunition stockpile information, EF uncertainties, and data quality issues associated with the EFs in the draft AP-42 Chapter 16 (AP-42, 2011) OB/OD emission factor database, and uncertainties in the sampling methods.

Tests for OB replicated common disposal practice through placement of the propellant into steel pans on a concrete slab (see Figure 2-2 and AP-42, 2011). Burns are typically initiated with an electric match or black powder train and last for less than three minutes. The test setup and execution during this emission characterization effort included propellants, initiating materials, setup, and energetic amounts typical of OB demilitarization processes. Appendix G contains a site diagram of the OB pad.

OD is generally conducted in holes or pits with the energetic items exposed or covered with soil. Detonations are often initiated using an electric blasting cap or plastic explosives such as C4, A-3, or TNT (AP-42, 2011). This work similarly placed the munitions into four pits dug into the ground and left open to the air or covered with soil as required to mimic production conditions (see Figure 2-9 as well as Appendix G for a site diagram). The test setup and execution during this air emission characterization effort included energetics, munition items, initiating materials, pit design, setup (both soil covered and uncovered), and energetic amounts encountered during OD demilitarization processes.

Figure 2-1. Munitions tested: A) Comp B, B) Warhead V453 with C4 donor charge, and C) Warhead V548.

Figure 2-2. ARC propellant A) ARC 451 and B) ARC 452A.

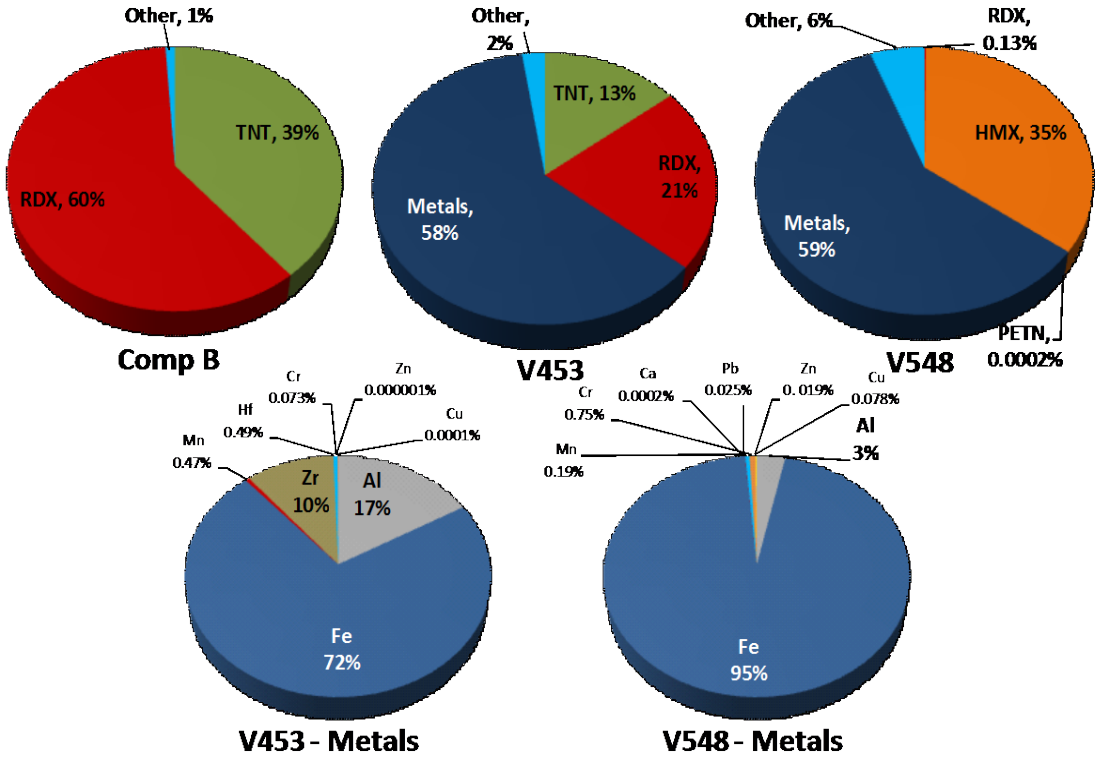


Figure 2-3. Major composition of the munitions studied including casing.

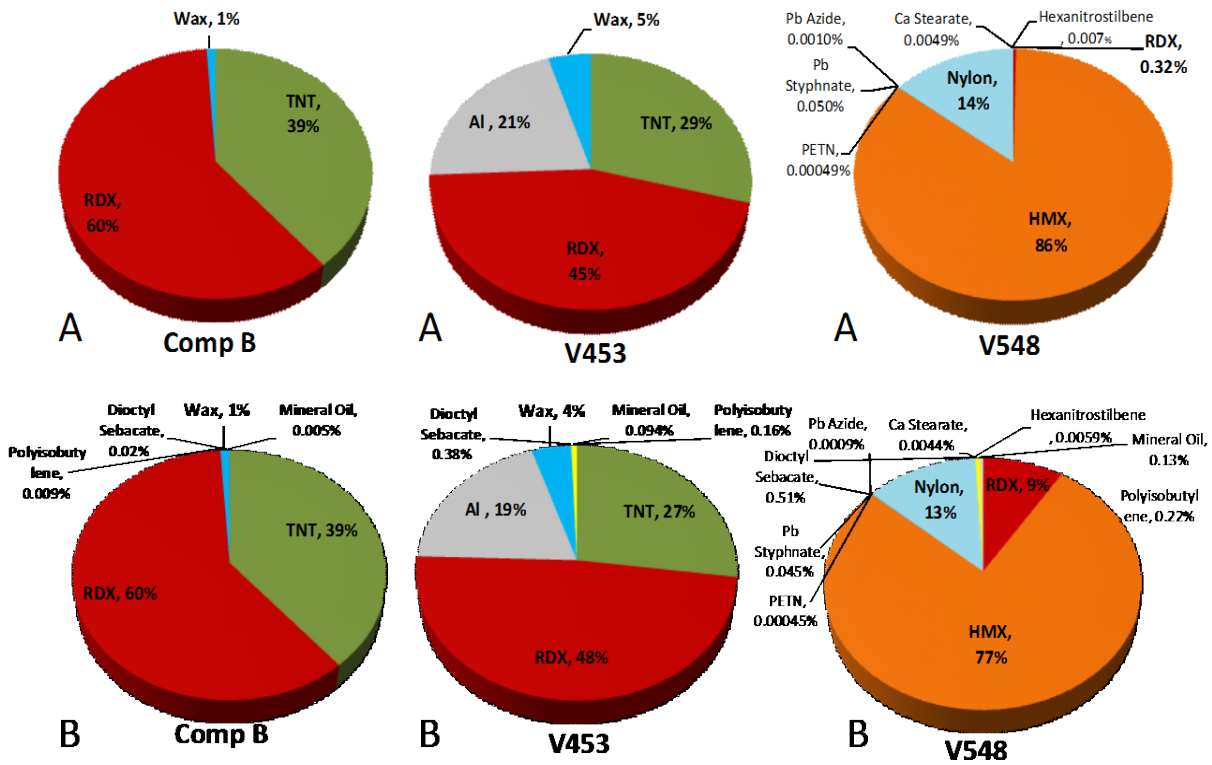


Figure 2-4. Major composition of the munitions studied A) without casing and B) without casing including donor charge.

Table 2-1. Composition of the Munitions and ARC Propellant Test Materials.

DODIC	Description & (NSN)	Casing Material	Weight (%)						NEW (lb/kg)	GWT (lb/kg)
			RDX	TNT	HMX	C	Other	AP		
None	Comp B	None	60	39	-	25	-	-	60/27	60/24
V453[a]	WHD GM MK90, H6 fill, (1336003989993)	Thick-wall steel	45	29	-	22	Al:21	-	65/29	141/64
V548	WHD Section GM HE WAU-17B (Sparrow), (PBXN-3 fill), (1336011292305)	Thick-wall steel	0.32	-	86	23	Pb:0.0235, Si:Ca:trace	-	35/16	86/39
M130	M6 Electric Blasting Cap	Cu	4.5	-	-	73	Pb: 0.92 Plastic: 83	-	0.046/ 0.02	0.070/ 0.03
MN90	M23 Non-electric Blasting Cap	Fe	-	-	0.28	0.046	Al:0.070 Pb: 0.0006	-	1.9/ 0.86	2.0/ 0.91
C4/M023	M112 Demolition/donor Charge	None	90	-	-	22	Dioctyl Sebacate: 5.3	-	1.25/ 0.566	1.26/ 0.571
ARC 452A[b]	Arcadene	None	-	-	-	9.4	Al:19, Cl:20, Fe:0.7	69	54/24.5	54/24.5
ARC 451[b]	Arcadene	None	-	-	-	9.7	Al:19, Cl:20.82	69	54/24.5	54/24.5

NSN, NATO stock number; NEW, net explosive weight; GWT, gross weight; DODIC, Department of Defense Identification Code; HMX, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; RDX, hexahydro-1,3,5-trinitro-1,3,5-triazine.

[a]V453 has a 9 lb shaped charge of 8.6 lbs Zr and 0.4 lbs Hf.

[b] Information obtained from AEROJET MSDS.

2.2 Aerostat Sampling Method

An aerostat-borne instrument package named the "Flyer" (Aurell et. al, 2011) was used to sample emissions from field OD and OB in pans. This aerial sampling method used two ground-based ATVs, each with a remotely-controlled electric winch for 1000 ft [305 m] tethers, to anchor and maneuver a helium-filled aerostat, which carried a Flyer (Figure 2-5). A Kingfisher (K16N) 16×13 foot-diameter [4.9×3.9 m-diameter] helium aerostat lofted the 46 lb [21 kg] Flyer. The combination of two ATVs and two tethers permitted the positioning of the aerostat, and therefore the Flyer, at a specific location and height downwind of the detonations and burns of AP-containing propellant. After initiating detonations and burns, the Flyer was repositioned optimally in the visible plume by controlling the electric tether winches. For very windy conditions (>20 mph) which precluded safe operations with the aerostat, the Flyer was mounted on a forklift positioned downwind of the detonation site (see Figure 2-6).

Figure 2-5. Aerostat with Flyer (L) and aerostat attached to two ATVs (R).

Figure 2-6. Ground based OD sampling during very windy conditions.

There are two Flyer models and each is constructed with lightweight, aluminum frame structures that can be assembled with multiple sampling and monitoring configurations to meet changing testing requirements (Figure 2-7). Each Flyer includes an on-board computer, control software, and wireless transmitters which allow sampling to be controlled from the ground. Sampling is also controlled using "triggers" and software to operate multiple on/off valves. These triggers, for example, allow one to loft multiple SUMMA canisters and trigger their valve openings at different CO_2 concentrations. The large semivolatile/energetic blower can be either turned on or off from the ground or by enabling the blower's CO_2 trigger. The on-board computer and wireless data transfer also allows the ground crew to monitor CO_2 concentration, battery life, and pressure drop across a filter in real time. Monitoring these data remotely allows maximization of flight time and optimization of sample collection by avoiding problems such as premature battery change-outs or battery depletion and signaling the need for changing plugged filters. All sensor data and flow rates are logged to the on-board computer. In addition, the Flyer has a global positioning system (GPS) on board to pinpoint position and altitude.

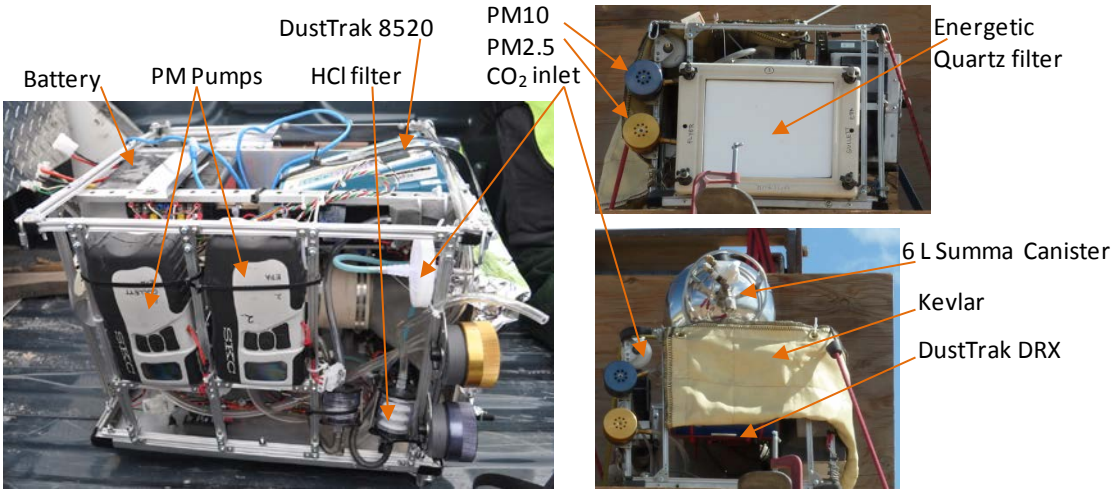


Figure 2-7. Three views and configurations of the Flyer.

The Flyer was configured for this project with a CO_2 continuous emissions monitor (CEM), CO electrochemical cell, VOC sampler using a SUMMA canister, semivolatile (energetic) sampler using a quartz filter, PM_{10} and $PM_{2.5}$ filter samplers, HCl sampler using a filter and silica sorbent, perchlorate filter sampler, and a PM CEM sampler. For this work, the semivolatile method cited in the original QAPP was focused entirely on energetics. On the advice of JMC, the method was modified to only include the quartz filter as previous results have shown the energetics to be virtually all particle-bound. Removal of the polyurethane foam (PUF)/XAD-2 sorbent in the sampler reduced the pressure drop and afforded a higher collection rate. New measurements reflect an increased focus on particles including the distribution of metal emissions by particle size and residual energetics on the particles. Two methods of Total PM measurement were added by expanding the sampling methods for PM collected in the inertial impactor samplers and semivolatile filter. These PM samplers provide information on the distribution of PM and metals across particle size categories of environmental interest (i.e., Total PM, PM_{10}, and $PM_{2.5}$). The

specific samplers used for each munition and propellant were selected based on the anticipated emission products. Table 2-2 shows the type of samplers used for each munition and propellant.

Table 2-2. Open detonation test matrix and analytes.

Test Item	Total Number of Det'ns	Total Charge NEW (lb/kg)	Soil Cover (ft/m)	PM & Metal Samples by Filter		PM by light scattering DustTrack (# det'ns)	Energetics Sample	CO, CO_2, VOCs by Canister	CO_2 by CEM
				Total PM/PM_{10} + Metals	Total $PM/PM_{2.5}$ + Metals				
Comp B	20	300/136	0	2	2	No	1	0	Yes
	15	300/136	3/0.90	4	4	No	4	1	Yes
	16	300/136	6/1.8	2	2	No	2	0	Yes
V453	12	195/88	3/0.90	3	3	Yes (4)	1	0	Yes
	12	195/88	6/1.8	3	3	No	3	0	Yes
	8	65/29	6/1.8			No			Yes
V548	22	106/48	3/0.90	2	2	No	3	1	Yes
	16[a]	106/48	3/0.90	6	6	Yes (10)	2	1	Yes

[a] Ground based air measurements due to high winds.

2.3 Test Site, Testing and Sampling Procedure

2.3.1 Open Detonation

The detonation site constructed for this effort consisted of three ~7 m high berms in a U-shape to partially shelter on-site equipment and facilities (Figure 2-8 and Appendix G). The first day of testing included unsampled trial detonations of Comp B (on the soil surface), K180 mines (covered by 3 feet [0.90 m] of soil), and V453 warheads (covered by 3 feet [0.90 m] of soil). The trial detonations allowed observations of plume behavior including height as well as shrapnel/rock throw. Soil samples were collected before these trial detonations to determine background concentrations in the soil. Although K180 mines were detonated on the first day, their emissions were ultimately not sampled because of time constraints.

Figure 2-8. Detonation site.

Detonation plumes were sampled by downwind pre-positioning of the aerostat/Flyer and then repositioning after the detonation based on plume height and direction. Pre- and post-detonation positioning of the aerostat into the plume was accomplished by both the pilot and an observer, both in radio communication and orthogonal to each other. Small balloons were occasionally used to provide visual evidence of both ground and aloft winds. A small (5 feet [1.5 m] diameter), "sacrificial" balloon was lofted to determine downwind distance and height versus shrapnel hazard. Movement of the main aerostat after the detonation was accomplished by aid of line-of-sight, radio-controlled winches mounted on two ATVs. These winches were controlled simultaneously by the aerostat pilot. While the ATVs and aerostat were inside the shrapnel safety arc, personnel were positioned outside the arc, maintaining controls and communication by radio.

NEW amounts were varied, with 300 lb [136 kg] for Comp B, a maximum of 195 lb [88 kg] for V453, and 106 lb [48 kg] for V548. Detonations only occurred when there were acceptable meteorological conditions (i.e., wind direction, wind speed, and ceiling height, effecting plume and auditory dispersion). Up to four series of four detonation tests were conducted per day. The cased munitions (warheads V453 and V548) were detonated with 3 feet or 6 feet [0.90 or/and 1.80 m] of soil cover (Figure 2-9) by placing the warheads in ~3-ft holes and covering to the ground level (for soil cover 3 feet, see Table 2-2) or covering 3 ft above the ground level (for soil cover 6 feet, see Table 2-2). Comp B was detonated at ground level (surface) and under 6 and 3 feet of soil cover to understand the emission variation with soil depth from uncased munitions. Figure 2-10 shows a crater from a V453 detonation.

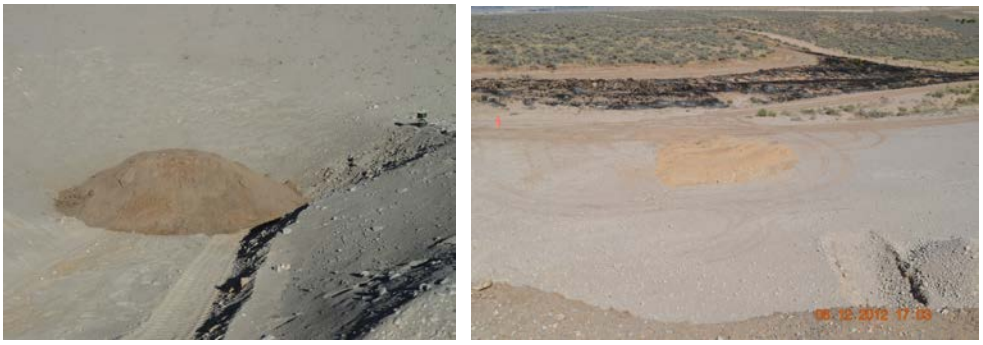


Figure 2-9. Covered munitions detonations.

Figure 2-10. Detonation crater of V453.

2.3.2 Open Burns

Four reusable metal burn pans were positioned in two rows situated on a concrete pad (~65 ft × 80 ft [~20 m × 25 m]). The propellants were placed in the metal pans then ignited (Figure 2-11). Between burns, the pans were broom-cleaned to remove all residues. Each pan held a single propellant charge size of 54-108 lb [25-49 kg] for both ARC 451 and ARC 452A. The number and type of emission samples collected are shown in Table 2-3. Data from these AP-containing propellant tests will supplement initial data taken in 2011 and reported in WP-2153.

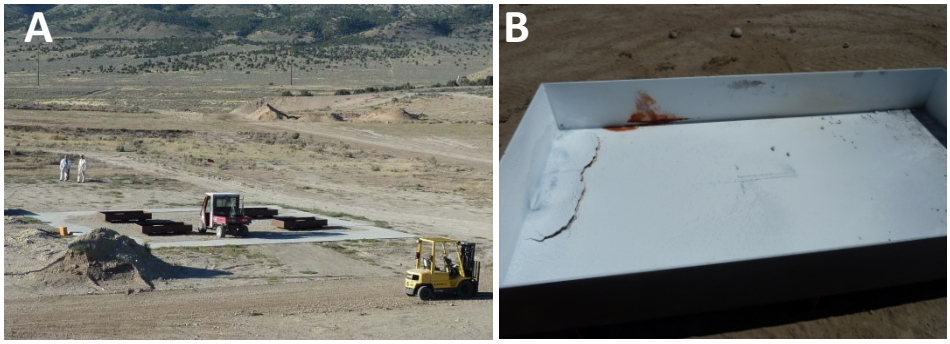


Figure 2-11. A) Concrete burn pad with four reusable burn pans, and B) burn pan after burn.

The Flyer was prepositioned downwind of the propellant burn site (Figure 2-12) with the aid of wind socks. The two ATVs equipped with electric winches and tethers were used to anchor and maneuver the Flyer. Vehicle drivers and all campaign participants were required to stay outside the safety zone around the OB pans. The propellant burns were ignited one by one when winds blew towards the prepositioned Flyer. When necessary, the Flyer was maneuvered into the plume by reeling the tethers in or out, as guided by visual observations.

Figure 2-12. Aerostat sampling of ARC propellant.

Table 2-3. Open burn test matrix and analytes.

Test Item	Burn Number	Total Number Blocks of Propellant in Each Burn	Charge size NEW (lb/kg)	PM & Metal Samples by Filter		HCl	Perchlorate	CO, CO_2, VOCs by Canister
				Total PM/PM_{10} + Metals	Total $PM/PM_{2.5}$ + Metals			
ARC 451	1	1	54/24	0	1	1	1	1
	2	2	108/49					
	3	2	108/49					
	4	2	108/49					
	5	2	108/49					
	6	2	108/49	1	0	1	1	0
	7	2	108/49					
	8	2	108/49					
	9	1	54/24					
ARC 452A	1	2	108/49	1	0	1	1	1
	2	2	108/49					
	3	1	54/24					
	4	2	108/49					

2.4 Emission Sampling and Analysis Methods

2.4.1 Carbon Dioxide by Non-Dispersive Infrared CEM and Carbon Monoxide by Electrochemical Cell

CO_2 measurements were performed using a LI-COR Biosciences LI-820 non-dispersive infrared (NDIR)-based CEM mounted on the Flyer. The LI-CORs use a 14 cm optical bench, giving an analytical range of 0-20,000 ppm, with an accuracy specification of <2.5% of reading. The instrument was preceded by a filter for particulate matter removal prior to the optical lens. Signal averaging was set to 2 seconds per reading. The LI-COR Bioscience LI-820 CEM was calibrated for CO_2 on a daily basis according to USEPA Method 3A (USEPA, 2008) using a zero gas (100 % nitrogen), span gas (4500 ppm CO_2), and gases of intermediate CO_2 concentrations (400 and 1500 ppm). A detailed description of the CO_2 CEM calibration procedure and drift data can be found in Appendix J.

CO was sampled continuously using a semi-real-time monitor. An onboard CO sensor (Creative Solutions RCO1000) measured CO concentration by means of an electrochemical cell through CO oxidation. Output is linear from 0 to 1000 ppm at an operating relative humidity range of 15-90%. The RCO 1000 was calibrated in the USEPA Metrology Laboratory prior to trip departure at 0 to 80 ppm with ± 2 ppm error using USEPA Method 3A (USEPA, 2008). CO measured by flow through the chemical cell was corroborated by the measurement of a sample taken from the SUMMA canister system and analyzed via gas chromatography.

2.4.2 SUMMA Canister Sampling for Volatile Compounds, Carbon Dioxide, and Carbon Monoxide

2.4.2.1 Sampling Method

Evacuated SUMMA canisters (6 L capacity) were used to collect VOCs via USEPA Method TO-15 (USEPA, 1999a). Canisters were obtained from a commercial laboratory Columbia Analytical Services (CAS) that could analyze for target analytes at low limits of detection. An electronic solenoid valve sampling system atop the SUMMA canister was opened and closed by a CO_2 concentration trigger circuit at operator-set levels. An electronic pressure transducer and a pressure gauge were attached to the SUMMA canister to provide information on the status of the SUMMA canister (i.e. empty, filling, or full) and the voltage equivalent of the SUMMA canister pressure was recorded on the onboard computer. The valve was followed by a 15 µm frit filter in the stem of the SUMMA canister resulting in an approximate sampling time of 15-30 seconds.

Prior to deployment, the SUMMA canisters were checked at the USEPA metrology laboratories for valve function (opening and closing) and sampling time. Prior to each experiment, the SUMMA canister electronic valve was checked to see if it opened and closed properly.

2.4.2.2 Analytical Method

VOCs were analyzed using USEPA Method TO-15 (USEPA, 1999a) with selective ion monitoring mode gas-chromatography mass spectrometry (GC/MS). A 1.0 L aliquot was pulled from the SUMMA canister and analyzed. An internal spiking mixture was added to the laboratory control sample. All surrogate standard recoveries were within the method acceptance criteria of the CAS laboratory, e.g. the surrogate standard recovery for benzene was 85% which was within its method acceptance criteria of 66-121%. A detailed VOC laboratory procedure description can be found in Appendix O.

Each SUMMA canister sample was also analyzed for CO_2 and CO by GC, utilizing USEPA Method 25C (USEPA, 1996a), in which an aliquot of the collected SUMMA canister sample was injected into a sample loop equipped GC/Flame Ionization Detector (FID). The CO_2 and CO surrogate standard recoveries were 92 and 100%, respectively, which are within the method acceptance criteria of the CAS laboratory: 73-132% and 71-123%, respectively.

2.4.3 Energetics and Their Byproducts

2.4.3.1 Sampling Method

Energetic compounds were analyzed from the PM collected on a large (10×8 inches, [20.3×25.4 cm]) quartz filter. These procedures were adopted based on past experience with energetic sampling at Dugway Proving Ground (U.S. Army, 1992d) which suggested that the airborne energetic compounds were solely associated with the particles. As discussed in Section 2.2, this assumption enabled the collection of a large sample using the Flyer’s high surface area filter and its high

volume pump in an effort to minimize or eliminate non-detects. In addition, the large quartz filter was pre- and post-weighed in the field under ambient conditions on the day of use in order to test its function as an additional total particle filter measurement (see Section 2.4.4 for more details).

The sampling was performed using a low voltage blower for a nominal sampling rate of 1.2 m^3/min. The blower was controlled by the CEM CO_2 trigger circuit or started from the ground by the operator via wireless control. Flow rate was measured by the pressure differential across a calibrated venturi. The venturi is a carefully calculated and constructed constrictor made and calibrated at the USEPA shop and Metrology Laboratory, respectively. As used here, it was mounted on the outlet of the semivolatile sampler. A venturi has the property that fluid pressure through a constricted section of pipe is reduced. The fluid velocity must increase through the constriction to satisfy the equation of continuity, while its pressure must decrease due to conservation of energy. As such, a measurement of ΔP between the venturi's inlet and constricted diameter body was used to calculate flow rate. In practice, a calibration curve was developed from ΔP and actual flow measurements. The voltage equivalent to this pressure differential was recorded on the onboard computer. The USEPA Metrology Laboratory performed these measurements using the venturi's matched transducer and data acquisition computer with a Roots meter.

Following sampling, the filter was removed from the Flyer, folded in half, placed within a doubled aluminum foil sleeve, and shipped to ALS Labs (Kelso, WA) for energetics analysis. The filters were not cooled during shipment as per the advice of ALS Labs and consistent with the relatively non-volatile nature of the energetics.

2.4.3.2 Analytical Method

The target residual energetic compounds included:

- HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
- RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine
- TNT - 2,4,6-Trinitrotoluene
- PETN - Pentaerythritol Tetranitrate
- Tetryl - Methyl-2,4,6-trinitrophenylnitramine
- 1,3,5-Trinitrobenzene
- 1,3-Dinitrobenzene
- 4-Amino-2,6-dinitrotoluene
- 2-Amino-4,6-dinitrotoluene
- DNT - 2,4-Dinitrotoluene
- 2,6-Dinitrotoluene
- 3,5-Dinitroaniline

ALS Labs followed the analytical procedures within USEPA Method 8321B (USEPA, 2007a) (although the target analytes are those covered in USEPA Method 8330 (USEPA, 2007b). Sequentially, the laboratory removed the filter from the aluminum foil, folded it into thirds, rolled it up, placed it into a 40 mL glass vial, spiked it with internal surrogates (1,3-dinitrobenzene-d4), added acetonitrile, agitated the vial, decanted the acetonitrile, concentrated by nitrogen blow down, diluted with acidified water for matrix matching, and then injected the sample into the detector. The target compounds' peak areas were analyzed with liquid chromatography and tandem mass spectrometry. The compounds were analyzed by an external standard method, using a 7-point quadratic calibration curve. The HMX and 1,3-dinitrobenzene surrogate standard recoveries were 73-101% and 86-114 %, respectively, which are within the method acceptance criteria of the ALS laboratory procedures (70-130% and 70-130%, respectively). The residual extract was returned to USEPA labs. A detailed laboratory procedure description can be found in Appendix O.

2.4.4 Particulate Matter and Metals

2.4.4.1 Sampling Method

$PM_{2.5}$ and PM_{10} were sampled simultaneously using two size-selective impactors (SKC, USA) with 47 mm tared Teflon filters (2 µm pore size) and two SKC Leland Legacy sample pumps with a constant airflow of 10 L/min. The internal flow sensor measured flow directly and acted as a secondary standard to constantly maintain the set flow. The volume display on the ground was continually updated based on corrected flow rate multiplied by sampling time. The pump operation (on and off) was controlled automatically by the CEM CO_2 trigger circuit or manually by the operator via wireless control from the ground. The SKC Leland Legacy sample pump was calibrated prior to and twice on-site during the sampling campaign with a Gilibrator Air Flow Calibration System (Sensidyne LP, USA), which is a primary standard airflow calibrator.

The use of an additional dedicated particle size sampler and pump for Total PM was deemed weight-prohibitive for the aerostat. To accommodate this constraint, the $PM_{2.5}$ and PM_{10} samplers were modified to also sample Total PM. The Total PM measurements consisted of the weight gain on a 37 mm polycarbonate disk pre-sprayed with Apeizon grease (mix of Apiezon grease and Hexane 1:20) and a downstream PM_{10} or $PM_{2.5}$ particle filter in series. The disk was pre-sprayed to obtain a sticky surface in order to avoid bouncing of larger particles down to the PM_{10} or $PM_{2.5}$ downstream particle filter. This disk was placed on the impactor plate of the PM_{10} or $PM_{2.5}$ cartridge. As mentioned previously, the 10×8 inches [20.3×25.4 cm] quartz filter on the semivolatile energetic sampler complemented the PM_{10} and $PM_{2.5}$ impactor modifications for a second Total PM measurement.

2.4.4.2 Analytical Method

The Teflon filters were obtained from a commercial laboratory (CHESTER LabNet) that could provide tared filters and analyze for PM and target metal analytes at low limits of detection. PM was measured gravimetrically as the difference between final and tare masses for each filter. The

weighing of the filters followed the procedures described in (40 Code of Federal Regulations (CFR) Part 50, 1987). Calibration for determining mass of conditioned media was performed as described in Quality Assurance Guidance Document 2.12 (USEPA, 1998). The polycarbonate Total PM impaction plate filter disks were weighed before and after sampling at USEPA following the procedures described in (40 CFR Part 50, 1987). For 19 of the 46 $PM_{2.5}$ and PM_{10} filters, large, loose particles were on the filter and in the petri dish. Presumably the high PM concentration in the plume made it possible for these particles to bounce off the impactor plate. These particles were size-analyzed under a microscope and verified to be much larger than PM_{10} or $PM_{2.5}$. The weight of these large, loose particles, weighed separately, was added to the Total PM fraction (polycarbonate disks).

The PM collected on Teflon filters was also used to determine concentrations of target metals: Pb, Hf, Zr, Al, K, Fe, Mg, Mn, Na and Ca, as well as twenty-nine other metals. The metal content on the Teflon filters was analyzed by X-ray fluorescence (XRF) according to USEPA Compendium Method IO-3.3 (USEPA, 1999b). The standard reference materials used for the QA/QC had a recovery of 96-106% which is within the method acceptance criteria (89-111%). The analytical laboratory out of necessity neglected the large, loose particles, tapping them off prior to the XRF analysis in order to make the analysis possible. These weights amounted to 1.6% ±1.6% of the total weight.

The Total PM impaction plate filter disks were prepared by USEPA Method 3050b (USEPA, 1996b) and analyzed for the ten target metals (Pb, Hf, Zr, Al, K, Fe, Mg, Mn, Na and Ca), determined by inductively coupled plasma (ICP) according to USEPA Compendium Method IO-3.4 (USEPA, 1999c). ICP, rather than XRF, was necessary for these analyses as the solids were present on the disk in the form of eight conical piles and were not amenable to XRF analysis. An internal spiking mixture of the target compounds was added to the CHESTER LabNet control sample. All surrogate standard recoveries were 80-115% which was within the method acceptance criteria (80-120%). The Total PM samples from the $PM_{2.5}$ impactor filter disks were not analyzed for metals since it was determined that one set of Total PM filters from the PM_{10} impactor would provide adequate metal results. Three Teflon filters were analyzed both by XRF and ICP for a methods comparison since the Total PM impaction plate disks and soil samples could only be analyzed by ICP (data available in Appendix F). The correlation coefficient between these three pairs of analyses was 0.83, high enough to warrant combination of the XRF filter and ICP filter disk analyses in the calculation of Total PM metal emissions. Detailed laboratory procedure descriptions for PM and metal analyses can be found in Appendix O.

2.4.5 Continuous PM

During some detonation series (V453 and V548), the PM concentration of the plume was continuously determined by a DustTrak DRX Aerosol Monitor (model #8533). This instrument measures light scattering by aerosols as they intercept light from a laser diode and has the capability of simultaneous real time measurement (every second) of PM_1, $PM_{2.5}$, Respirable (PM_4), PM_{10} and Total PM_{15}. The aerosol concentration range for the DustTrak DRX was 0.001-150

mg/m^3 with a resolution of ±0.1% of reading. Concurrently, an enclosed, 37-mm pre-weighed filter cassette provides a simultaneous PM_{15} gravimetric sample. The total flow rate is 3 L/min where 1/3 of the flow rate is used for the continuous measurements and 2/3 is used for the gravimetric sample. The enclosed gravimetric sample was used to conduct a custom photometric calibration factor (PCF) for PM_{15}, calibrating the photometric measurements against a gravimetric reference value. The DustTrak DRX is factory calibrated to the respirable fraction, with a PCF value of 1.00.

2.4.6 Perchlorate, Chlorate, and HCl

2.4.6.1 Sampling Method

Perchlorate (ClO_4^-) and chlorate (ClO_3^-) were sampled using a modified method from (Lamm et. al, 1999). The method consisted of sampling at a flow rate of 4 L/min through a 37 mm diameter mixed cellulose ester (MCE) filter (0.8 µm pore size) enclosed in a closed-face cassette (SKC Corporation). Perchlorate, chlorate, and chloride salts were captured as a solid on the filter, which assumes no perchloric acid formation. HCl was sampled in parallel by two different methods, as shown in Figure 2-13:

1. Alkali-impregnated filter according to International Organization for Standardization (ISO) Method 21438-2 (International Standard, 2009).
2. Silica gel collection according to National Institute of Safety and Health (NIOSH) Method 7903 (U.S. NIOSH, 1994).

Methods for sampling HCl are primarily derived from those intended for sampling inhalable HCl to relate to exposure risk. Silica gel collection methods may undersample HCl mist, as particle size collection characteristics on the silica gel sorbent tube do not match the inhalable convention (Howe, et. al, 2006). Although there are unanswered questions about the relevance of these methods for the inhalable particle/droplet size (Howe, et. al, 2006), we were interested in efficient capture and quantification. HCl was sampled in parallel using alkali-impregnated filters following the perchlorate filter and silica gel tubes. HCl gas is expected to pass through the perchlorate/chloride salt filter and be adsorbed by a second, quartz filter coated with Na_2CO_3. These coated filters are available in a cartridge from SKC Corporation. Any hydrochloric acid transiently collected on the initial filter is expected to rapidly evaporate and be collected along with the gaseous HCl (Howe, et. al, 2006). This method, including a pre-filter followed by a Na_2CO_3-impregnated quartz filter, is consistent with a method from France (Institut National de Recherche et de Sécurité, 2002) as cited in (Howe, et. al, 2006), which became a European standard method (International Standard, 2009).

These methods were used for sampling HCl and perchlorate from Sparrow rocket motors in the 2011 (WP-2153) study. For the Sparrow rocket motor, only a single 1 minute sample of each method was collected. Although there were a limited number of samples, the methods showed success since no breakthrough was found and the HCl and chlorate concentrations were 1000 and 100 times higher than the ambient air background concentration, respectively.

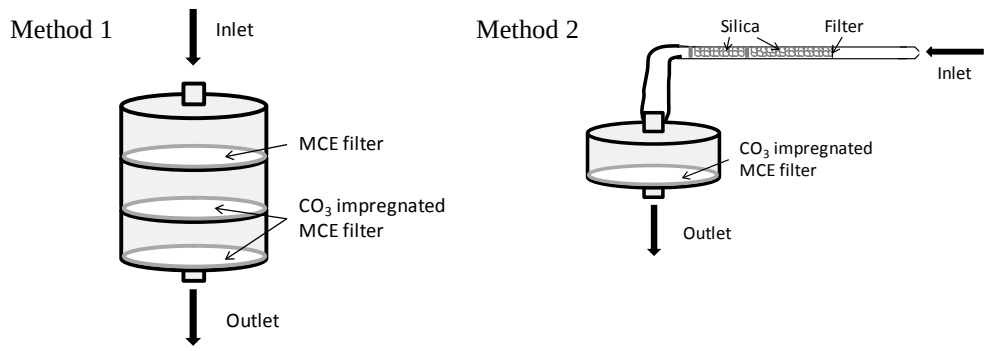


Figure 2-13. Sampling apparatuses for HCl, perchlorate, chlorate, and chloride salts. Filter method 1 (ISO 21438-2) followed by an additional CO_3 filter at the left, and silica gel method 2 (NIOSH 7903) followed by a CO_3 filter at the right.

2.4.6.2 Analytical Method

Cassette samples and the pre-filter in the silica tube were dissolved/extracted in water, an internal standard added, and the solution analyzed for perchlorate with liquid chromatography-mass spectrometry (LCMS) and chloride with ion chromatography as per USEPA Method 6850 (USEPA, 2007c). Samples were analyzed at CAS, NY. The perchlorate pre-filter and Na_2CO_3 filter both were analyzed for target analytes prior to sampling at Tooele in order to establish their potential contamination levels. Ambient air background levels were determined for perchlorate, chloride, and HCl. The chloride concentration on the MCE CO_3 filter and the silica were multiplied by a factor of 1.0284 in order to convert from anion (Cl^-) to acid concentration (HCl) (International Standard, 2009).

2.4.7 Soil

2.4.7.1 Sampling Method

A total of five different soil sampling efforts were conducted, including one prior to each of the three different detonation test series:

- Pit background – soil collected at the detonation site pits prior to all detonations, including the preliminary test trials.
- Post-detonation of Comp B – soil collected at the detonation site after detonation of Comp B and prior to detonation to V453.
- Sand fill background – soil collected outside the detonation area and brought into the detonation area to cover the munitions test series of V453 and V548.
- Post-detonation of V453 – soil collected at the detonation site after detonation of V453 and prior to detonation of V548.
- Post detonation of V548 – soil collected at the detonation site after detonation of V548.

Soil samples were analyzed for metals and energetics HMX, RDX, TNT and DNT. The purpose of these sampling efforts was to provide a preliminary understanding of whether the methods employed could discern if air emissions were related to contributions from soil or due to the munitions itself. For example, the first test munition, Comp B, has no metals in its composition, so the only metals present in the emission samples should be those from the surrounding soil. Analysis of soil and Comp B metal emissions could provide an assessment of the anticipated soil contribution to subsequent testing and information on the efficacy of soil sampling in future efforts to characterize soil contributions.

Metals and energetic concentrations in the soil (mass target/mass soil) were compared to their counterparts sampled at the Flyer. A ratio of the Flyer's plume concentrations to the soil concentrations could help determine the level of contribution of the soil to that of the Flyer sample. If a Flyer to soil ratio is high, it can be concluded that the soil's composition provides minimal input into the emissions. Conversely, a low ratio indicates that the soil's composition contributes substantially to the observed concentrations in the emissions. While the emission values could potentially be corrected for the contribution of the soil, the exploratory scope of the soil sampling and the minimal number of planned replicate samples was not assumed to be of sufficient confidence to warrant this analysis. An additional complicating factor in correcting plume concentrations for soil contributions is the inability to predict whether the soil partitions by aerodynamic particle size in the plume. The ejection and entrainment of soil particles may result in a different particle size distribution in the plume than in the sampled soil. If the elemental distribution in the soil is a function of particle size, then bulk soil sampling would not be expected to reflect the plume catch, as larger particles are less likely to be sampled in the plume.

The soil sampling method employed at Tooele was conducted with consideration of standard operating procedures for range sampling (Appendix A of Hewitt et. al, 2007). The limited number of samples allowed in the budget plan, however, restricted our ability to fully characterize the soils prior to and after detonations. Five scoop samples were taken from 1 m^2 areas and combined to comprise a single sample within a labeled, zip-locked plastic bag. It was recognized ahead of time that this limited soil sampling plan would likely prove insufficient to fully characterize the potentially heterogeneous soil composition at the Tooele Test Range. The site was subject to considerable earth-moving in preparation for the testing, including construction of a natural berm. In addition, the testing itself was expected to contribute to the soil composition throughout the course of the campaign. Diagrams showing locations of soil sampling sites can be found in Appendix G.

2.4.7.2 Analytical Methods

Each of the five soil samples underwent energetic and metal analysis. Samples were analyzed for metals (Zr, Hf, Al, Fe, Mn, Ca, K, Mg, Na, Pb) using USEPA Compendium Method IO 3.4 (USEPA, 1999c) acid digestion followed by ICP, USEPA Method 200.7 (USEPA, 1994). Energetics (HMX, RDX, TNT, PETN, Tetryl, 1,3,5-Trinitrobenzene, 1,3-Dinitrobenzene, 4-Amino-2,6-dinitrotoluene, 2-Amino-4,6-dinitrotoluene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 3,5-

Dinitroaniline) were analyzed as per Section 11.1.4 of Method 8330A (USEPA, 2007b) for nitroaromatics.

2.4.8 Sampling Time

The sampling times for the semivolatile filter, PM_{10} and $PM_{2.5}$ impactor filters, HCl, and perchlorate filter/silica were all initiated either automatically from the CO_2 trigger level or manually by the operator. The sampling durations were identical and the cessation of sampling was based upon the CO_2 concentration falling back below the set trigger level since reduction of the CO_2 concentration indicates the passage of the plume. The sampling duration was different for the SUMMA canister since it was initiated and terminated with a separate adjustable CO_2 trigger circuit. A higher CO_2 trigger concentration was used for the SUMMA canister to insure that sample was gathered near the peak concentration of the plume. When the canister filled to approximately 80-90%, it would cease to collect sample and the valve would close. Sampling times for all of the instruments were recorded by the Flyer's onboard computer.

2.4.9 Calculation of Emission Factors

Values of CO_2 concentrations from the CEM and SUMMA canisters and CO from the SUMMA canisters were used to calculate a co-sampled carbon concentration, permitting conversion of analyte concentrations to emission factors by the carbon mass balance method. In the carbon mass balance method, the ratio of the sampled target analyte concentration to the total sampled carbon (represented here by CO_2) is related back to the initial munitions weight through knowledge of the carbon concentration/carbon fraction in the original munitions, the assumption of 100% oxidation of the carbon, and the ability to sample a representative plume fraction. In all emission factors, the background concentration of the target analyte, determined from Flyer-based instruments and ground-based upwind instruments, is subtracted from the measured amount.

The CEM CO_2 concentrations were used for calculating all carbon concentrations except for determination of VOC emission factors from the SUMMA canisters. For the latter, CO and CO_2 data directly from the canister sample were used. For one canister (V548 warhead with 3 feet of soil coverage), CO_2 levels were inexplicably low (i.e., below ambient). In this case, the canister CO level was added to the simultaneous CEM CO_2 values to calculate total C sampled.

Emission factors were calculated according to (Draft Chapter 16, AP-42, 2011):

$$EF_i = f_c \times \frac{Analyte_{ij}}{C_j} \quad \text{where:}$$

EF_i = Emission Factor for target analyte i (lb/lb NEW).

f_c = mass fraction of carbon in the munitions

$Analyte_{ij}$ = background-corrected concentration (lb $analyte_i/ft^3$) of the target analyte i collected from the volume element j of the plume.

C_j = background-corrected concentration of carbon (lb C/ft^3) collected from volume element j of the plume (carbon calculated from CO_2 data from either the CEM or the SUMMA canister).

These emission factors were converted to appropriate units of the fraction of conserved species present in the emissions compared to that present in the munitions (Draft Chapter 16, AP-42, 2011). This conversion was calculated as follows:

$$EF_i = \frac{f_c}{f_i} \times \frac{Analyte_{ij}}{C_j}$$

where:

EF_i = Emission Factor for target analyte i (emissions analyte *I* in lb/lb *i* in munitions).

f_c = mass fraction of carbon in the munitions.

f_i = mass fraction of analyte *i* in the munitions

$Analyte_{ij}$ = background-corrected concentration (lb $analyte_i/ft^3$) of the target analyte i collected from the volume element j of the plume.

C_j = background-corrected concentration of carbon (lb C/ft^3) collected from volume element j of the plume (carbon calculated from CO_2 data from either the CEM or the SUMMA canister).

3. Results and Discussion

The Flyer successfully sampled emissions from 71% of the 109 open detonations from different munitions types and soil cover depths, and 100% of the 13 open burns of AP-containing propellant (Table 3-1 and Table 3-2), as determined by the number of times that the CO_2 concentration exceeded the ambient air CO_2 concentration (by $\geq$ 2 ppm). Each measured exceedance of the ambient CO_2 concentration was referred to as a "hit." "Misses" were due to unanticipated plume paths primarily due to wind shifts and dilution of the plume with ambient air. Misses are slightly higher than in previous years' work with bulk explosives due to additional standoff distance to avoid rocks and fragments from the soil and munition casing. Figure 3-1 shows photos from some of the different munition types and soil cover depths. The total number of samples collected for each munition and propellant is shown in Table F1 of Appendix F.

Table 3-1. Sampling success – open detonation.

Munitions Buried depth	Comp B[a] Surface	Comp B[b] Surface	Comp B 3 feet	Comp B 6 feet	V453 3 feet	V453[b] 6 feet	V548 3 feet	V548[c] 3 feet
No. of detonations	20	16	15	16	12	12	22	16
No. of hits	15	15	13	8	9	8	14	10
Hits (%)	75	94	87	50	75	67	64	63
Avg. Plume sampling time (s)	13	13	20	8	33	19	9	18
Average ΔCO_2 (ppm)	21	21	19	27	9	5	6	12

[a] With the first four trial detonations. [b] Without eight low NEW detonations. [c] Ground based sampling during high winds.

Table 3-2. Sampling success – open burning.

	ARC 451	ARC 452
No. of burns	9	4
No. of hits	9	4
Hits (%)	100	100
Avg. Plume sampling time (s)	62	64
Average ΔCO_2 (ppm)	88	71

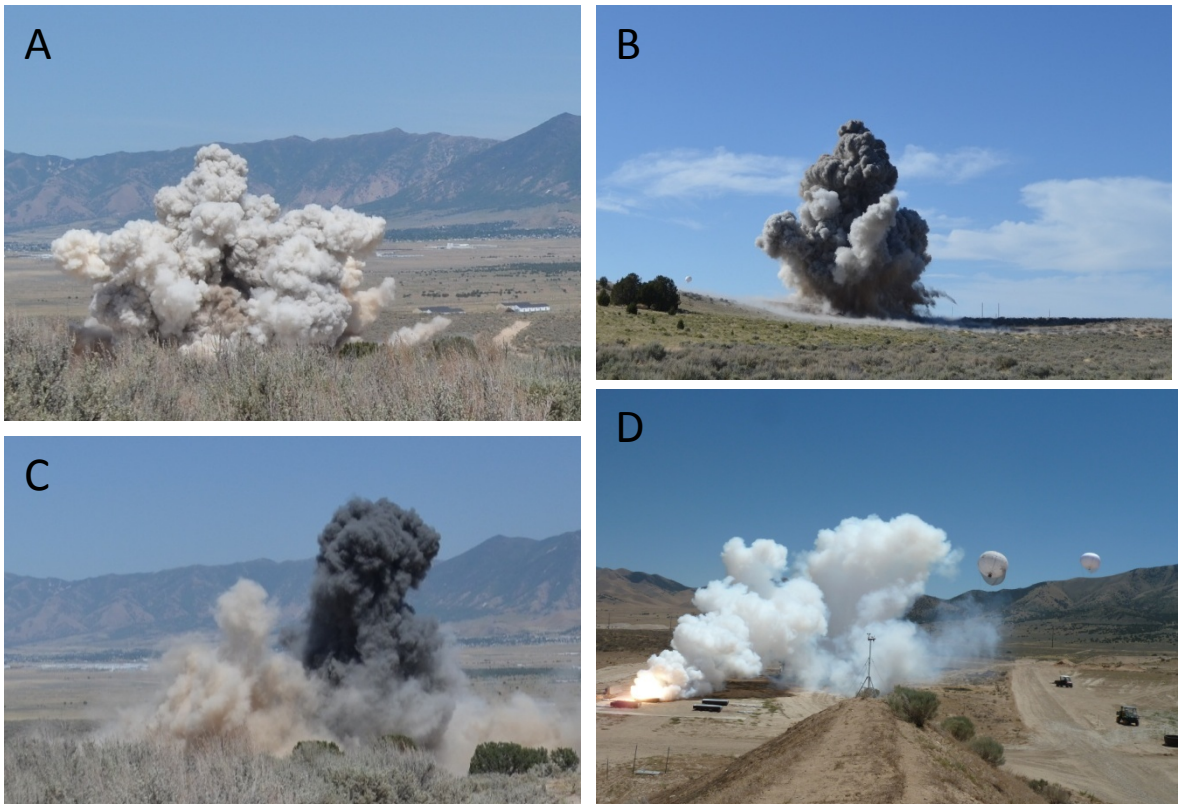


Figure 3-1. Photos of open detonation of A) Comp B covered with 3 feet of soil, B) V453 covered with 3 feet of soil, C) V548 covered with 3 feet of soil, and D) open burning of ARC propellant.

3.1 Carbon Dioxide by NDIR CEM and Carbon Monoxide by Electrochemical Cell

Four examples of in-plume CO_2 concentration changes over time are shown in Figure 3-2. Depending on the wind speed it took approximately 15 to 55 seconds for the plume to reach the aerostat/Flyer after detonation. Average CO_2 concentrations above ambient ranged from 5 to 27 ppm for the munition detonations. These values are considerably lower than in previous years' tests. This can be attributed to the increased stand-off distance required for the aerostat and Flyer during this year's detonation of soil-covered and metal-cased munitions. As discussed in Section 2.4.9, the NDIR CEM CO_2 emission results were used to determine the majority of the emission factor results from this work. Appendix P contains CO_2 CEM raw data.

No CO was detected using the semi-continuous electrochemical cell for any of the detonations or propellant burns. This was likely due to the short sampling time in each plume, the minimal CO concentration present, and the long response time required for the cell (~90 seconds) relative to the duration of the sampler in the plume. This result is consistent with past year's sampling.

Figure 3-2 also includes plume temperatures which were monitored to ensure that the instruments were not exposed to excessive heat. Peak temperatures did not exceed approximately 3 °C above ambient at the Flyer, indicating the rapidity with which plume dilution occurred.

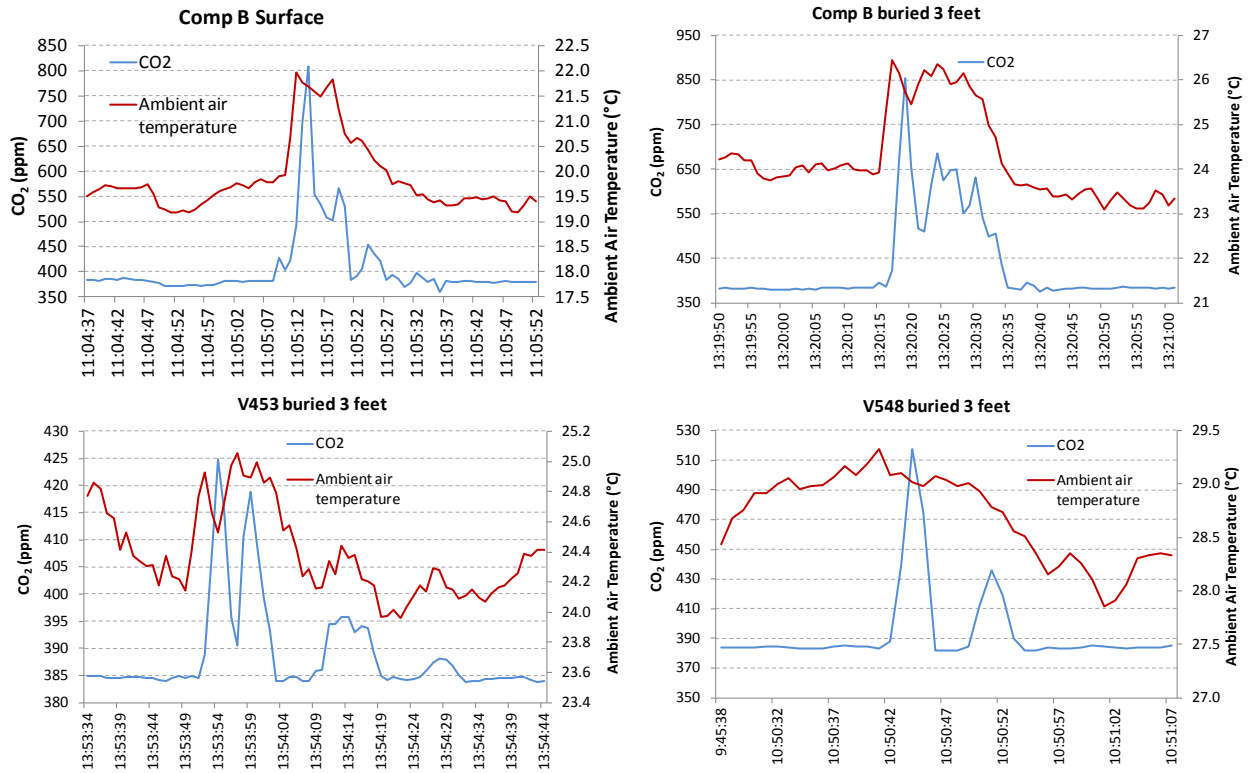


Figure 3-2. In-plume CO_2 concentration (uncorrected for ambient) and ambient air temperature traces for some of the detonations.

3.2 SUMMA Canister Sampling for Volatile Organic Compounds, Carbon Dioxide, and Carbon Monoxide

The short plume residence times for the Flyer meant that multiple plume samples were necessary to fill the SUMMA canisters, resulting in multi-detonation, composite samples. The SUMMA canister electronic valve was triggered open by an operator-set CO_2 level. To avoid VOC concentrations in the canister below the method detection limit, higher concentrations, presumably associated with higher CO_2 concentrations, were manually targeted by the operator. To accomplish this, the CO_2 trigger level was set relatively high, then adjusted downward with successive detonations (if necessary) until the sensors indicated that the canister was filled. In addition, this study increased the size of the SUMMA canister to 6 L (versus 1 L in 2011) to obtain a larger sample mass and minimize detection issues. The SUMMA canisters' average ΔCO_2 and CO concentrations as well as VOC emission factors are shown in Table 3-3 and the complete dataset for both detonations and propellants are shown in Appendix F, Tables F14 and F15. The CO_2 values are higher than the multi-plume averages reported in Table 3-1, confirming that presumably higher VOC concentrations were preferentially sampled, as intended. A laboratory report with full analytical results for CO, CO_2, and VOCs is shown in Appendix N.

Comparison of CO and CO_2 concentrations in the SUMMA canisters can be used only in a qualitative sense to compare sampling success and plume characteristics, as variation in plume collection efficiency (e.g., sampling dilute portions of the plume) and ordnance composition (differences in carbon content) can easily lead to distinction in results. CO was detected in the SUMMA canisters that sampled the detonations at levels near to those of the CO_2 concentrations, implying an incomplete carbon oxidation. Conversely, no CO was detected in the SUMMA canisters that sampled the burning of the AP-containing propellant (method reporting limit (MRL) = 8 ppm). As the close proximity of the sampler to the propellant burns ensured sufficient sampling, the absence of CO implies complete combustion of the AP-containing propellant (within the detection limits of the method). These non-detect CO concentration results are in accordance with the 2011 reported values of CO from AP-containing propellant combustion (Kim et. al, 2012).

CO was also analyzed using a continuous electrochemical cell. However, the low levels of CO and the short duration of the plume resulted in all non-detects, even with the detonations, due to the cell's minimal sensitivity and slow response time.

The CO_2 concentrations in the ARC 451 and ARC 452A propellants (80 ppm and 30 ppm, respectively were lower than the combined 2010 and 2011 reported values (average of 490 ppm ± 125, projects WP-1672 and WP-2153) from single-, double- and triple-base propellants, but in the same range as the AP-containing Sparrow rocket motor (20 ppm) tested at the Tooele Production Range (Kim et. al, 2012). These results are consistent with expectation as the AP-containing propellant has a lower carbon fraction (~0.10) than the single- to triple-based propellants (0.18-0.29). Lower CO_2 concentrations may also be the result of burn and sampling times that were approximately three times longer than the single- to triple-based propellants.

VOCs detected from the SUMMA canister included the common combustion products benzene, toluene, ethylbenzene, and xylene (BTEX) as well as other compounds. Ambient air background samples were also taken with SUMMA canisters (Appendix F, Table F15). It should be noted that benzene concentrations, as well as several other compounds from the ambient air background samples, were below detection limits. Full coverage of VOC results is presented in Table F14 and Table F15 in Appendix F. The BTEX compounds for the three munitions types, each covered with 3 ft of soil, had emission factors in the 10^{-3} to 10^{-4} lb/lb C range and were within approximately an order of magnitude of each other. Good agreement is noted for the benzene emission factors for V548 (5.7E-03 lb/lb C) and V453 (1.2 E-03 lb/lb C) (both covered with 3 feet of soil). Comp B had a ten times lower benzene emission factor (3.5E-04 lb/lb C) than the other munitions types, despite similar soil cover (3 foot depth) conditions, but was similar to the 2010 TNT surface detonation levels (Kim et. al, 2010) of 2.6E-04 lb/lb C. The reader is reminded that the emission factors found in Table 3-3 are based on limited results; more replicates may be necessary to ensure accuracy and confidence in the values for covered detonations.

No detectable VOC levels were found (Table 3-3) for the ARC 451 and ARC 452A propellants, despite having collected a higher CO_2 concentration than last year's Sparrow rocket motor results which had detectable VOC levels at lower CO_2 levels.

Table 3-3. VOC sampling results from SUMMA canisters and average emission factors for all non-zero ΔCO and ΔCO_2 results.

	Comp B 3 feet	V 548 3 feet [a]	V 453 3 feet	ARC 451	ARC 452A
ΔCO_2 (ppm)	90	20	15±5	80	30
CO (ppm)	100	11	13±3	ND[b]	ND
Benzene (lb/lb Carbon)	3.5E-04	2.0E-03	1.2E-03 ±2.2E-04	ND	ND
Toluene (lb/lb Carbon)	1.5E-04	8.1E-04	6.7E-04 ±4.9E-04	BBL[c]	BBL
Ethylbenzene (lb/lb Carbon)	ND	5.8E-05	8.1E-04 ±6.1E-05	ND	ND
Xylene (lb/lb Carbon)	7.0E-05	ND	2.5E-04[d]	ND	ND
1,2,4-Trimethylbenzene (lb/lb Carbon)	3.7E-05	ND	4.5E-05[d]	ND	ND

[a] Carbon calculations based upon SUMMA canister CO and the CO_2 from the simultaneous CEM data – SUMMA CO_2 was below ambient background level. [b] ND, Not detected. CO non-detect values were ignored when calculating the emission factor. [c] BBL, Below background levels. [d] Only one sample with detectable levels.

3.3 Energetic Compounds

Due to the short sampling duration of each detonation, multiple events were used to create single, composite samples for energetics. These single samples were obtained by using the same filter media without replacement during multiple, sequential OD events. One to four composite emission samples were collected for each munition type and soil cover depth. Ideally, energetic levels in the soil, background air, and emission samples could be compared for each energetic to discern whether energetics in the sampled emissions were from energetics released from the munition or due to entrainment of soil surrounding or covering the detonation. Results for all energetic air and soil samples collected during the field campaign are shown in Appendix F, Figure F-1 and Tables F2, F3, F4, and F5. Appendix L contains a laboratory report showing complete energetic analytic results from the soil samples. Appendix K contains a laboratory report showing complete energetic analytic results from the air samples.

HMX, RDX, and TNT were detected in two ambient air background samples collected on different days. Detection of these energetics may be attributed to the sampler position; the background sampler was placed on a small crate atop a 15 foot berm and may have collected wind-swept soil on the filters with trace energetics. Despite this, the test detonation plume concentrations of HMX, RDX, and TNT were significantly higher than the background samples, respectively ranging from 55-2480, 92-1750, and 43-860 times higher than the ambient air concentrations.

Figure 3-3 shows the chronological energetics levels in the soil (right side axis) and in the PM air samples (left side axis) throughout testing. TNT was found in the single, initial soil sample prior to testing (Figure 3-3) at about 10 µg/kg of soil. As considerable TNT testing had been done on this range in 2010 and 2011, finding TNT in the soil is not wholly unexpected. However, the test range had undergone substantial earth moving to prepare a protective berm for these detonations, so finding TNT in the soil was a bit surprising. The soil cover during the initial detonations was comprised of a large numbers of rocks which caused safety and equipment hazards upon detonation of Comp B. Hence, the cover material was replaced with fine sand found in a nearby, excavated location. This fine sand fill cover was used for all detonations subsequent to Comp B sampling. The single fine sand fill sample used for covering the V453 and V548 munitions showed no detectable energetic levels, including TNT ("Sand Fill", Figure 3-3).

Detonation of Comp B, which contains both RDX and TNT (see pie chart, Figure 3-3) resulted in air emissions of both RDX and TNT, but also a comparatively small amount (113 µg/kg of particulate matter) of HMX (see "Comp B Surface" on Figure 3-3). The initial, pre-detonation soil sample showed no HMX (Figure 3-3) so this is not likely a source although there is some question of pre-detonation HMX levels since a complete soil characterization was not performed. However, RDX may contain minor amounts (4 to 15% by weight) of HMX (Mitchell and Suggs, 1998) and the detonation cord used in all of the tests consisted of 80% HMX. Both of these sources may have contributed to the HMX found in the air samples. The TNT level in the COMP B surface detonation plume sample was about 600 µg/kg PM. This concentration is about 60 times that in the initial, single soil sample and is either due to emissions from the munition itself or due to biased air sampling of plume-entrained, TNT-enriched fine soil particles. As the RDX concentration was also 600 µg/kg PM in the emissions but was below detection limits for the initial soil, it is reasonable to assume that the TNT source in the emissions is primarily due to Comp B, as was RDX, and that no significant entrainment of TNT from the soil occurred.

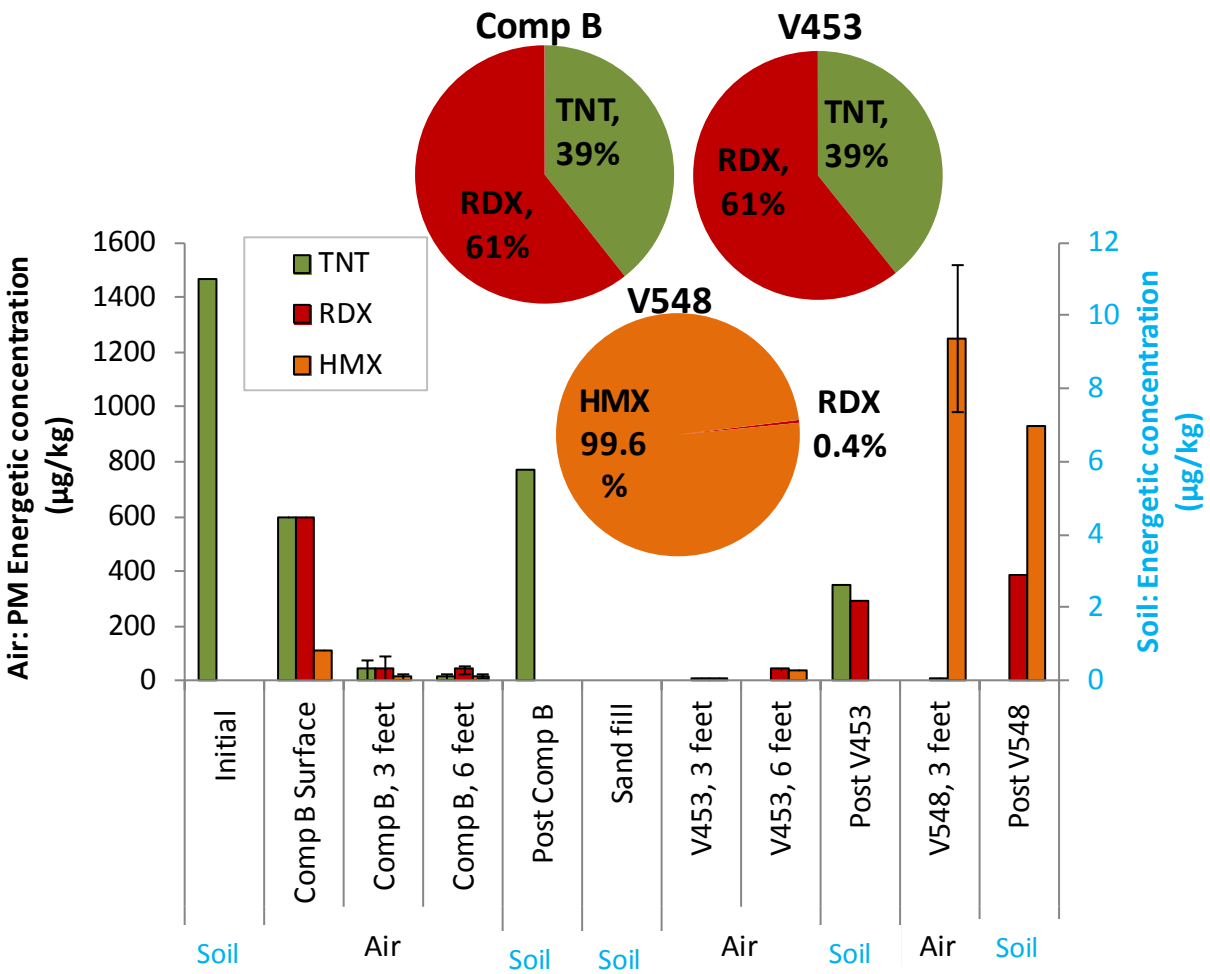


Figure 3-3. Chronological energetics level in the soil and the PM samples throughout the testing. PM (air) concentrations on left Y-axis and soil concentrations on right Y-axis. Pie charts show energetic composition in each of the munitions.

Energetics analysis of a single soil sample from the detonation pits after the surface and soil-covered Comp B detonations ("Post Comp B," Figure 3-3) shows detectable levels of only TNT (6 µg/kg soil), similar to the pre-detonation sample (initial 11 µg/kg soil). Despite Comp B's majority composition of RDX and TNT, the former was not detected and the latter did not increase in concentration. However, it should be emphasized that the soil sampling was exploratory only and did not constitute a robust characterization of the potential energetics fate in the surrounding soil. Soil sampling and analysis was added to this work only as an exploratory concept; further definition of soil effects would require a more robust sampling campaign, especially in view of the challenging terrain and frequency of excavation and soil cover work during the field campaign.

Soil covered detonation of Comp B (both 3 ft and 6 ft) showed significantly diminished (~10-fold) plume energetic to PM ratios of all three major energetics compared to Comp B surface

detonations (Figure 3-3), suggesting either that less energetics from the munitions were entrained into the detonation plume or that more soil PM with lower energetic concentration was entrained into the detonation plume. The average concentration of TNT in the plume PM (28 µg/kg PM, Appendix F, Table F4) exceeded that of the initial soil TNT level (11 µg/kg soil, Appendix F, Table F5). HMX was also detected in the PM sample from both soil-covered Comp B detonations (3 ft and 6 ft) at about a 6-fold diminished level from the surface detonation, reflecting its likely presence in the munitions itself.

Buried detonation of V453 (3 ft and 6 ft) resulted in plume PM concentrations of HMX and RDX only (TNT was not detected), ranging from 10 - 42 µg/kg PM. These levels are comparable to those found with soil-covered Comp B. Like Comp B, V453 contains only TNT (39% by mass) and RDX (61% by mass), so the presence of HMX may be attributable to the minor component reported in RDX, the HMX in the detonation cord, and the pre-testing trial detonations (all three munitions types which contain RDX and potential trace amounts of HMX). Despite TNT comprising 39% by mass of the V453 energetic, it was not detected in the soil-covered detonation plume. Low levels of RDX (10 - 42 µg/kg PM) compared to Comp B surface emissions (600 µg/kg PM) support the role of soil-covered detonations in minimizing the energetic/PM ratio that is likely a consequence of a large increase in soil PM. The soil sample taken after the V453 detonations ("Post V453", Figure 3-3) indicates the presence of both TNT and RDX. TNT was observed in all earlier soil samples from the detonation pit, albeit at slightly higher levels. RDX is present (2 µg/kg soil) in the detonation pit soil for the first time, despite its presence in earlier detonations of Comp B.

Buried detonations of V548 (99.6% HMX and 0.4% RDX by mass) resulted in over 1200 µg HMX/kg PM in the emissions, indicating residual energetics in the detonation plume. Comparably minimal RDX was found (10 µg/kg PM), indicating that minimal contaminated soil from the V453 testing was entrained. Analysis of a single soil sample after V548 detonations ("Post V548", Figure 3-3) shows the first detectable level of HMX in soil samples and RDX levels similar to soil samples after V453 detonations. The increase in soil HMX appears to be from the munition's formulation. The RDX presence in the soil is likely residual from previous detonations (Comp B, V453, and K180) or from levels of energetic already existing at the Tooele Test Range.

Energetic emission factors from detonation plumes are shown in Figure 3-4 and Table 3-4. The table contains three energetics, three energetic combustion byproducts (i.e., 2-amino-4,6-dinitrotoluene, 2,4-dinitrotoluene, and 3,5-dinitrotoluene), and one compound, PETN, that appears to be from the detonation cord. The energetic emissions from V548 had an approximately fifty times higher HMX emission factor than the other munitions studied; its presence could be expected since over 99% of V548's composition is HMX.

Figure 3-4 indicates that, unlike the energetic/PM concentration in Figure 3-3, soil-covered detonations may have higher energetic emission factors per mass of carbon in the munitions than do surface detonations. This is likely due to the much higher amounts of soil PM containing ener-

getics entrained into the plume, although the possibility of a lower combustion efficiency from covered detonation would also be a consistent explanation.

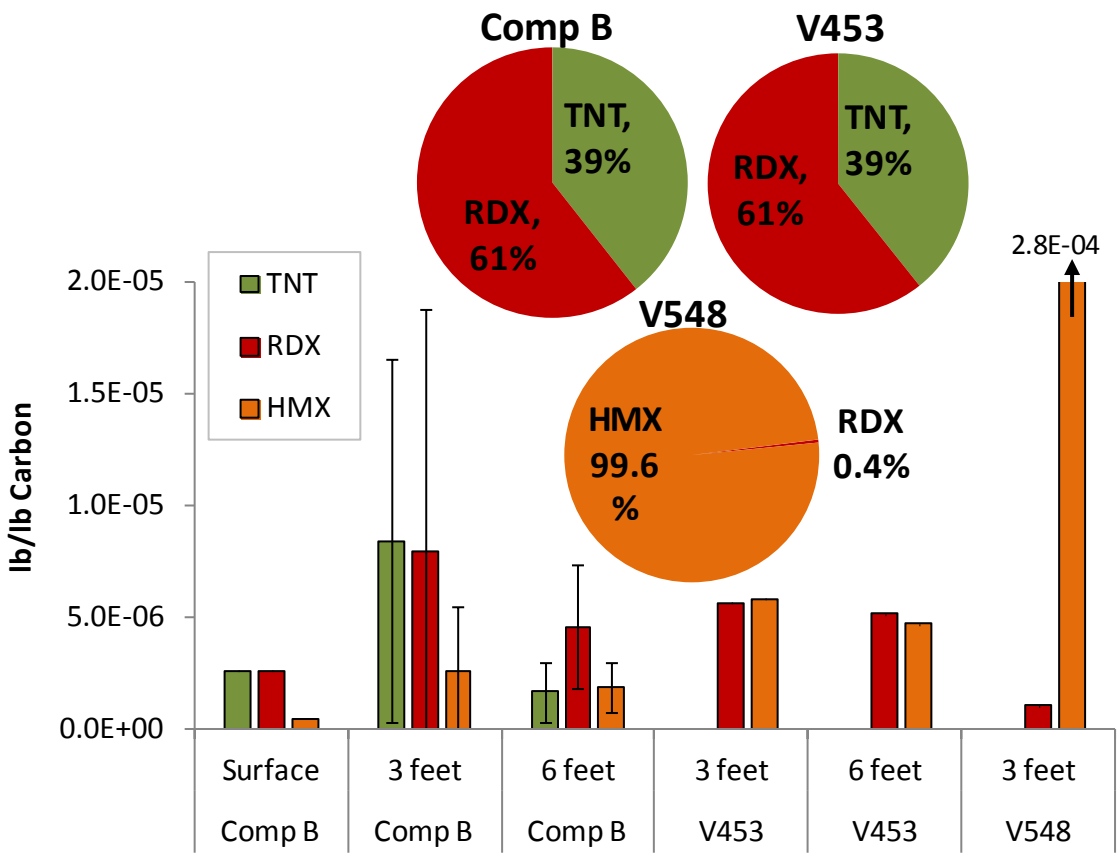


Figure 3-4. Energetics in air samples from different munitions and soil coverage depths; tests shown in chronological order. The pie diagrams shows the component percentage of energetics against the total amount of energetics. MDLs are listed in Appendix F, Table F3.

Table 3-4. Energetic emissions in lb/lb C.

		ΔCO_2 (ppm)	RDX	TNT	HMX	2-Amino-4,6-DNT	2,4-DNT	3,5-Dinitroaniline	PETN
Comp B Surface	Avg.	86	2.6E-06	2.6E-06	4.9E-07	1.0E-07	1.0E-06	ND	2.6E-07
	N	DNA	1	1	1	1	1	1	1
	STDV	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
Comp B 3 feet	Avg.	62	7.9E-06	8.4E-06	2.6E-06	6.5E-07	1.1E-05	ND	5.5E-07
	N	DNA	3	2	3	4	3	4	2
	STDV	DNA	1.1E-06	DNA	2.9E-06	6.8E-07	4.2E-06	DNA	DNA
	AD/2	DNA	DNA	8.1E-06	DNA	DNA	DNA	DNA	2.3E-08
Comp B 6 feet	Avg.	49	4.6E-06	1.7E-06	1.9E-06	5.3E-07	8.9E-06	ND	ND
	N	DNA	2	2	2	2	2	2	2
	AD/2	DNA	2.8E-06	1.3E-06	1.1E-06	4.7E-08	6.9E-07	DNA	DNA
V453 3 feet	Avg.	15	5.6E-06	ND	5.8E-06	3.0E-06	ND	2.4E-06	5.8E-06
	N	DNA	1	1	1	1	1	1	1
	STDV	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
V453 6 feet	Avg.	12	4.7E-06	ND	5.2E-06	2.1E-06	ND	2.5E-06	ND
	N	DNA	1	1	1	2	3	1	3
	STDV	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
	AD/2	DNA	DNA	DNA	DNA	1.6E-07	DNA	DNA	DNA
V548 3 feet	Avg.	20	1.1E-06	ND	2.8E-04	ND	ND	ND	4.7E-06
	N	DNA	1	3	3	3	3	3	1
	STDV	DNA	DNA	DNA	2.3E-04	DNA	DNA	DNA	DNA

ND, not detectable; N, number of ND samples or detectable samples; STDV, standard deviation; DNA, does not apply since single sample; AD, Absolute difference.

The amounts of energetics released to the air, as compared to that present in the munitions, are shown in Table 3-5. These are the units used for the energetic emission factors as presented in draft AP-42 Chapter 16 (AP-42, 2011). Most of these emission factors are a combination of the emissions from energetics in the munition and any energetic that was contained in the soil. This is not true when a munition does not contain an energetic. In that case, the emission factor with these units cannot be calculated and soil borne energetics cannot be estimated. For detectable energetics, the releases of RDX, TNT, and HMX ranged from about 1E-06 to 5E-06 lb/lb energetic for all but V548; V548 showed HMX and RDX releases of about 7E-05 lb/lb energetic (± 6E-05 lb/lb energetic). The larger HMX emission factor from V548, and the relatively high post-detonation soil concentration of HMX (Figure 3-3) suggest that soil-covered detonation of V548 produces higher amounts of unexploded energetic than the other munitions types.

The comparable emission factors for Comp B surface, covered with 3 ft of soil, and covered with 6 ft of soil in Table 3-5 as compared to Figure 3-3 are reflective of the higher amount of soil PM released into the air during soil-covered detonations. The larger amount of soil sampled per amount of energetic during soil-covered (versus surface) detonations diluted the emission factor expressed as mass of energetic per mass of sampled PM. These three modes (surface and covered

with 3 ft and 6 ft of soil) appear generally equivalent in terms of their energetic reactivity as reflected in similar emission factors, Table 3-5. In general, there were limited numbers of composite samples and large variations in the results and further testing may be required to increase confidence in energetic emission factor results.

Table 3-5. Emission factors in lb/lb Energetic.

		RDX	TNT	HMX
Comp B Surface	Avg.	1.1E-06	1.7E-06	DNA
	N	1	1	DNA
	STDV	DNA	DNA	DNA
Comp B 3 feet	Avg.	3.3E-06	5.4E-06	DNA
	N	3	2	DNA
	STDV	4.5E-06	DNA	DNA
	AD/2	DNA	5.2E-06	DNA
Comp B 6 feet	Avg.	1.9E-06	1.1E-06	DNA
	N	2	2	DNA
	AD/2	1.2E-06	8.7E-07	DNA
V453 3 feet	Avg.	2.8E-06	ND	DNA
	N	1	1	DNA
	STDV	DNA	DNA	DNA
V453 6 feet	Avg.	2.5E-06	ND	DNA
	N	1	1	DNA
	STDV	DNA	DNA	DNA
	AD/2	DNA	DNA	DNA
V548 3 feet	Avg.	7.5E-05	DNA	7.4E-05
	N	1	DNA	3
	STDV	DNA	DNA	6.0E-05

STDV, standard deviation; DNA, does not apply; AD, Absolute difference. For emission factors, Comp B does not include an HMX component and V548 does not include a TNT component.

3.4 Particulate Matter and Metals

3.4.1 Particulate Matter

Multiple detonation and burn events were used for collection of composite PM_{10}, $PM_{2.5}$ and Total PM samples. Two to twenty PM_{10}, $PM_{2.5}$, and Total PM filter samples were collected for each munitions type/soil cover depth scenario. In all, 103 PM filter samples were collected including 59 for Total PM using three different methods, 22 for PM_{10}, and 22 for $PM_{2.5}$. Complete PM emission analyses are shown in Appendix F, Tables F6 and F7. Appendix M contains a laboratory report showing complete analytic results for PM from the impactor filter samples.

$PM_{2.5}$ emission factors ranged from 0.42 lb $PM_{2.5}$/lb NEW (the average of the two surface detonation values) to 13 lb $PM_{2.5}$/lb NEW for the munition/soil-covered detonation trials with an average relative standard deviation of 57%. The average $PM_{2.5}$ emission factor for the seven detonation scenarios was 9.7 lb $PM_{2.5}$/lb NEW with an average standard deviation of 58%. These high mass values relative to the NEW mass underscore the obvious fact that the majority of the PM in the plume is derived from entrained and ejected soil rather than from particles originating from the munitions. This munition to soil PM partitioning is discussed later in Section 3.4.2.

The PM_{10} emission factors for the munitions detonations range from 0.29 lb PM_{10}/lb NEW (the average of the two surface detonation values) to 445 lb PM_{10}/lb NEW (V453 with 6 ft soil cover). The average PM_{10} value of the six munition/soil-covered detonation trials was 237 lb PM_{10}/lb NEW, with an average relative standard deviation of 142%. The PM_{10} emission factor for the surface detonation of Comp B was in the same range as the surface detonation of TNT in the 2010 study (WP-1672), 0.29±0.13 lb PM_{10}/lb NEW and 0.13±0.07 lb PM_{10}/lb NEW, respectively.

The PM_{10} measurements from the soil-covered detonations generally had very high emission factors compared to their companion $PM_{2.5}$ emission factors (Table 3-6). This is likely due to the presence of relatively large sand/dirt particles characteristic of the site that were ejected by the blast and entrained into the plume.

The regression point displacement (RPD)/relative standard deviation (RSD) values for $PM_{2.5}$ and PM_{10} are 57% and 98%, respectively, and are a reflection of variation in the plume particle density. Plumes from repeat ordnance/soil cover scenarios often had quite distinctive plume appearances. As a consequence, the Flyer likely sampled plume transects of varying particle loading, leading to variation in PM measurements. Lastly, PM samples for V548 (3 ft soil cover) collected from both ground-based and aerial based samplers show that the ground-based measurements had roughly equivalent or higher PM emission factors for all size categories measured by the impactors (Table 3-6). Since there is less time and space for PM fallout, ground samplers would be expected to be subjected to higher concentrations of larger particle sizes than aerial samplers.

Total PM values were obtained from the energetics filter, and the pre-impactor plates of the $PM_{2.5}$ and PM_{10} samplers. These three trial methods were employed to avoid the weight penalty associated with a separate sampler and pump for Total PM. Total PM from the energetics filter ranged from 1 to 126 lb PM/lb NEW (Figure 3-5 and Table 3-6) for all of the detonations, with the lowest value from the surface detonations of Comp B and the highest from V453, 3 ft soil cover. Total PM from the $PM_{2.5}$ sampler ranged from 0.6 to 71 lb PM/lb NEW, with the lowest value from Comp B, surface and the highest from the surface-sampled detonation of the V548, 3 ft soil cover. Total PM from the PM_{10} sampler ranged from 0.43 lb PM/lb NEW for Comp B, surface to 476 lb PM/lb NEW for V453, 6 ft cover.

There are differences between the Total PM emission factors from the three trial methods (Table 3-6). This is, in part, due to the limited number of intra-method replicates and their variability:

the average RPD/RSD for the Total PM values for the energetics filter, $PM_{2.5}$, and PM_{10} methods were 59%, 62%, and 102%, respectively. More replicates would likely reduce these numbers. In addition, observations support the contention that the methods did not sample equivalently. Many of the impactors had large, loose particles which did not adhere to the filter but were loose in the impactor cassette. The large particles are expected to be collected on the first sampling plate which was sprayed with Apeizon grease (1:20 mix of Apeizon grease and hexane). Their presence was certainly a consequence of overloading the initial impactor plates due to the high mass loading in the plume, causing the particles to bounce to the PM filter. The loose particles were added to the Total PM fraction but not the $PM_{2.5}$ or PM_{10} fractions. It seems that these samplers, designed for ambient air sampling and small particles, apparently are unable to handle the large particles and mass loadings present in detonation plumes.

This postulate seems likely, as the Total PM values from the PM_{10} impactor are much higher than those from the $PM_{2.5}$ impactor for covered detonations. The PM_{10} impactors have larger inlet orifices than the $PM_{2.5}$ sampler, allowing larger particles to more easily pass into the sampler. Similarly, the Total PM values from the PM_{10} impactor are much higher than those from the energetics filter, as the latter is unlikely to sample and retain large particles due to its vertical orientation. Indeed, visual observation of the energetics filter confirmed the absence of these large, loose particles. Future sampling efforts with the $PM_{2.5}$ and PM_{10} impactors should employ a pre-separator to prevent very large particles from entering the impactor as these samplers are not designed to handle the high mass loadings experienced during detonations. Based on the large variations and observed sampling problems with the $PM_{2.5}$ and PM_{10} impactors, additional testing is needed to obtain more substantiated emission factors.

The effect of soil cover on PM emission factors can be observed by comparing the results from detonation of Comp B on the surface and at 3 ft and 6 ft soil cover. Table 3-6 shows that all of the PM emission factors are higher with soil-covered detonation than with surface detonation. For example, the values from the energetics filter and the $PM_{2.5}$ impactors show approximately a 20- to 30-fold PM Total emission factor increase during soil-covered detonation. No conclusive distinction can be made between soil-covered detonation at 3 ft and at 6 ft for both Comp B and V453; additional test efforts could be designed to further evaluate impacts of burial depth on air emissions.

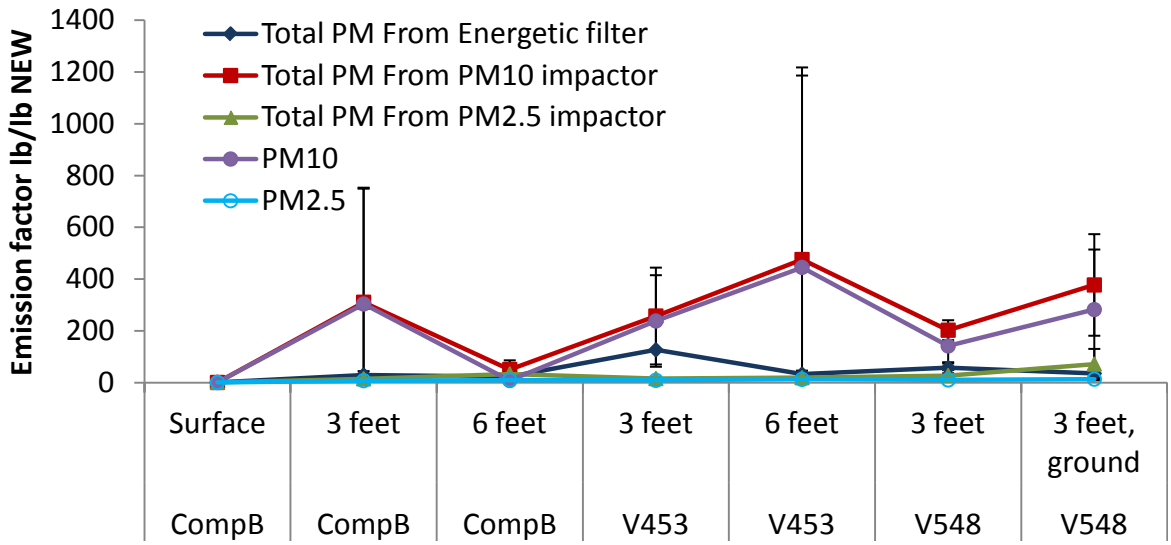


Figure 3-5. PM emission factors in lb/lb NEW.

Table 3-6. PM emission factor in lb/lb NEW.

Open Detonation			**Total PM From energetics filter** lb/lb NEW	**Total PM From PM_{10} impactor** lb/lb NEW	**Total PM From $PM_{2.5}$ impactor** lb/lb NEW	**PM_{10}** lb/lb NEW	**$PM_{2.5}$** lb/lb NEW
CompB	Surface	Average	1.1	0.43	0.61	0.29	0.42
		N	1	2	2	2	2
		AD/2	DNA	0.24	0.12	0.13	0.09
		RPD (%)	DNA	111	40	91	42
CompB	3 feet	Average	29	310	14	304	7.4
		N	4	4	4	4	4
		STDV	15	443	7.0	446	6.1
		RSD (%)	52	143	48	147	83
CompB	6 feet	Average	23	51	33	8.0	9.7
		N	2	2	2	2	2
		AD/2	8	35	8	1	3
		RPD (%)	70	139	50	28	67
V453	3 feet	Average	126	257	16	238	8.8
		N	1	3	3	3	3
		STDV	DNA	187	4.9	177	0.9
		RSD (%)	DNA	73	32	74	11

Open Detonation			Total PM From energetics filter lb/lb NEW	Total PM From PM_{10} impactor lb/lb NEW	Total PM From $PM_{2.5}$ impactor lb/lb NEW	PM_{10} lb/lb NEW	$PM_{2.5}$ lb/lb NEW
V453	6 feet	Average	33	476	19	445	13
		N	3	3	3	3	3
		STDV	14	742	4.9	741	4.3
		RSD (%)	42	156	26	167	34
V548	3 feet	Average	57	202	27	142	10
		N	2	2	2	2	2
		AD/2	21	38	21	67	7
		RPD (%)	74	38	154	95	130
V548	3 feet, ground	Average	45	377	71	282	13
		N	2	6	6	6	6
		AD/2	21	DNA	DNA	DNA	DNA
		RPD (%)		DNA	DNA	DNA	DNA
		STDV	DNA	196	59	232	4.6
		RSD (%)	DNA	52	82	82	35
ARC 452A		Result	NS	15	NS	0.31	NS
		N	NS	1	NS	1	NS
ARC 451		Result	NS	7.6	0.30	0.28	0.25
		N	NS	1	1	1	1

STDV, standard deviation; NS, Not sampled; DNA, Does not apply (less than 3 samples); AD, Absolute difference.

3.4.2 Metals in PM

A total of 50 $PM_{2.5}$, PM_{10}, and Total PM filter (from the PM_{10} impactor only) samples were analyzed for metals in order to derive emission factors and to begin to distinguish between contributions to the PM from soil-borne metals and from metals contained in the munitions. Comparison of metal emissions in the plume sample with those in the soil has potential for differentiating soil and munition contributions to the emissions. This is particularly true for those metals that are unique to the munitions and are not expected in the natural soil. As shown in Figure 2-3, the V453 warhead contains Zr and Hf; two metals present only in this warhead and not commonly found in the soil. Measurement of these two metals was targeted in the hope of distinguishing soil from munition plume contributions. Complete metals emission and soil analyses results are shown in Appendix F; Tables F8, F9, F10, F11, F12, and F13. Appendix M contains a laboratory report showing complete analytic results for metals from the impactor filter samples and soil samples.

The ability to attribute metal emissions to the munition alone rather than the soil is complicated by the likelihood of particle size bias upon detonation. Smaller particles are more likely to be entrained into the plume and sampled by the Flyer. This size partitioning of soil particles may have the effect of enriching the plume with smaller, higher surface area soil particles that have a higher concentration of specific detonation site metals, thus minimizing the relevance of the metal composition of the bulk soil samples. Alternatively, larger soil granules may have a distinctive composition to that of their smaller counterparts.

An additional complication results from the compositional impacts to the cover soil and surrounding soil from previous detonations. Even use of fresh soil cover may lead to complications, as the detonation shock wave and entrained flow will lead to surface contributions beyond the immediate footprint of the detonation.

Lastly, adequate characterization of soil elements is a significant sampling effort beyond the scope of the exploratory methods pursued herein. Heterogeneity of metal concentration in the soil and soil and movement from both heavy machinery and the detonations themselves complicate the statistical sampling process necessary to obtain representative and accurate soil concentrations.

The major soil metals (Ca, Fe, Al, K, Mg, Na, Mn) are shown in Figure 3-6 and Appendix F, Table F12. This composition was consistent across the limited number of samples (5) with an average RSD for these seven elements of 9.6 %. Hafnium (Hf), a component of V453, was not detected in the soil samples, affording the opportunity to attribute all Hf in PM emissions to the munitions rather than the soil. Zr was present in the soil at 0.026%.

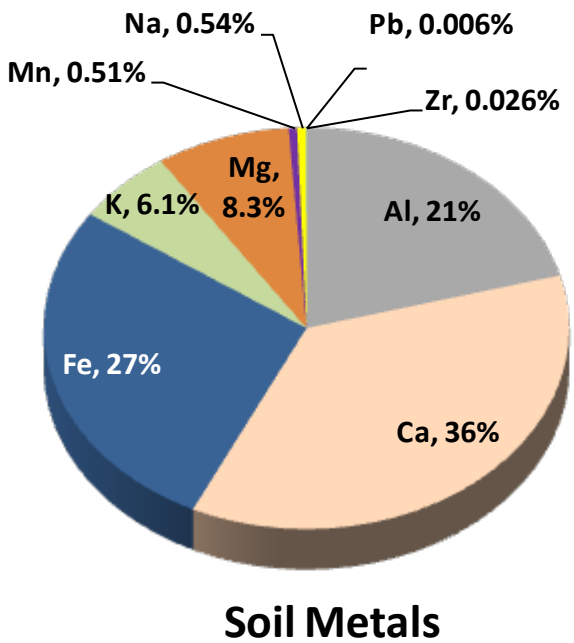


Figure 3-6. Metal composition in soil, average of all five collected samples. Hafnium was not detected.

Figure 3-7, A-F, shows the metal concentration percentages in the plume PM samples and their associated soil samples for all munitions and soil cover depths. Major soil elements showing enrichment in the plume samples included Al, K, and Na while Ca and Fe showed depletion. This suggests that the detonation results in metal-specific partitioning of the soil in the plume cloud, although the limited number of soil samples tempers this conclusion. This is likely due to heterogeneity of metal concentration in the soil, the differences in particle sizes sampled in the plume versus the soil, and the characteristic of different soil particle sizes to have different elemental compositions. This hypothesis is supported by the observation that, for example, the Al in Total PM is of lower concentration than $PM_{2.5}$ or PM_{10}. Minor elements suggesting enrichment included Zr, Hf, and Pb, while Mn showed depletion.

The enrichment/depletion trends for Comp B are of particular interest since Comp B contains no metals. Plume samples for Comp B should reflect the natural enrichment/depletion of metals from detonations due to partitioning of the metals by particle size. The phenomenon of metal enrichment/depletion by particle size complicates the ability to distinguish the plume PM samples for soil contributions versus munitions metals.

Comparison of the Zr concentrations in the bulk soil samples (see Figure 3-6) with the $PM_{2.5}$ and PM_{10} samples from Comp B (surface, 3 ft, and 6 ft) (Figure 3-7 A-C) shows about a 4-fold enrichment in the emissions. As Comp B contains no Zr, this result shows that bulk soil samples are likely inadequate for ascribing metals in air samples to the soil or the munitions.

Interestingly, Hf, not detected in the two soil samples prior to use of the Hf-containing V453, is sufficiently enriched in the air PM samples to exceed detection limits, and has an average concentration of 0.03 µg/g (calculated from results found in Appendix F, Tables F8, F9 and F10) for the emissions from the non-metal-containing, Comp B surface detonation. This Hf may be surface contamination from the pre-test, trial detonations. This apparent plume enrichment with Hf is more limited in the soil-covered detonations of Comp B to the point that Hf does not appear at all in the PM sample for the Comp B with 6 ft of soil cover. Whether the plume-enriched smaller particles contain more Hf than their bulk soil counterparts or whether surface detonations are more successful at entraining surface contaminated soil than covered detonations, it's clear that attribution of plume emissions to the ordnance composition is not a straightforward task.

Table 3-7 shows the metal in the PM samples as a ratio to the metals contained in the munitions. These are the units used for the metallic emission factors in the AP-42 Draft Chapter 16 (AP-42, 2011). Most of the emission factors from our testing include the emissions from any metal that is contained in the entrained soil. This is not true when a munition does not contain a metal. In that case, the emission factor with a denominator based on the amount of metal in the munition cannot be calculated and soil borne metals cannot be estimated. Values greater than unity indicate metal amounts above those available from the munitions indicating a source from the entrained soil or metal enrichment due to particle size effects. Values less than unity indicate the munitions' metals are not completely emitted into the plume and are likely partially retained in the soil as large or small metal fragments.

Al typically has values greater than unity (Table 3-7), regardless of particle size, most likely due to entrainment of Al from the soil. In V548, Pb also averages a metal fraction above unity, suggesting either contribution of Pb from the soil, or enrichment of the Pb-containing particles possibly due to a vaporization/condensation mechanism. Zr and Hf, present as an alloy in the shaped charge of V453 at a mass ratio, Zr/Hf, of 21/1, has five PM ratio values less than 0.9/1 (Table 3-7), with three of these (V453, 6 feet) less than 0.1/1. A sixth ratio is at 1.8/1. The significant change in this ratio from that of the original composition is intriguing since these metals are alloyed and might not be expected to show differential behavior. Some portion of the ratio changes may occur from soil contributions of Zr and Hf. Nonetheless, their presence in the emissions at emission factors significantly less than one indicates that metals in the ordnance do not wholly partition to the emissions – the majority partitions to the soil as large or small metal fragments.

Table 3-8 shows the metal values for Al and Fe in the plume-collected PM from the propellants ARC 451 and ARC 452. In the case of the propellants, emission factors less than unity indicate that the metals were most likely retained in the ash in the burn pans. Only a single composite sample from each of the ARC 451 and ARC 452A propellants was possible due to the light mass loading of the plume and the limited number of trials. ARC 451 and ARC 452A had about 7% and 10%, respectively, of their Al emitted into the plume based on PM sampling. Results for Fe show a greater range, between 10 and 39%. Additional tests should be conducted to verify these single-sample results.

Table 3-7. Metal emission factors (fraction of select metals found in PM emission samples, in lb/lb metal).

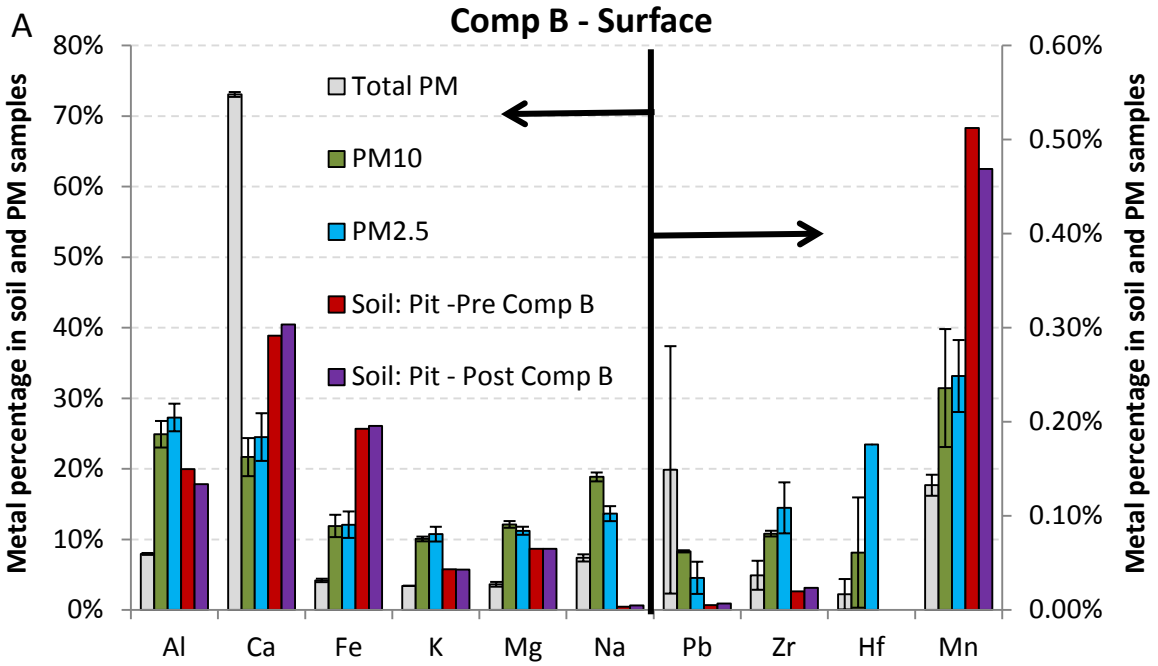
		$PM_{2.5}$ (lb/lb metal)						Total PM (lb/lb metal)[a]					
		Al	Hf	Zr	Fe	Mn	Pb	Al	Hf	Zr	Fe	Mn	Pb
V453 3 feet	Avg	1.9	0.0027	0.0049	0.087	0.25	DNA	1.8	0.012	0.010	0.27	0.82	DNA
	N	3	1	3	3	3	DNA	3	1	3	3	3	DNA
	SD	1.4	DNA	0.0017	0.026	0.072	DNA	0.31	DNA	0.0025	0.072	0.23	DNA
		PM_{10} (lb/lb metal)											
		Al	Hf	Zr	Fe	Mn	Pb						
	Avg	0.92	0.012	0.0042	0.089	0.25	DNA						
	N	3	1	3	3	3	DNA						
	SD	0.39	DNA	0.0013	0.017	0.049	DNA						
		$PM_{2.5}$ (lb/lb metal)						Total PM (lb/lb metal)					
		Al	Hf	Zr	Fe	Mn	Pb	Al	Hf	Zr	Fe	Mn	Pb
V453 6 feet	Avg	1.8	0.093	0.0084	0.20	0.46	DNA	3.7	0.22	0.012	0.57	1.7	DNA
	N	3	2	3	3	3	DNA	3	2	3	3	3	DNA
	SD	1.1	0.036[a]	0.0040	0.12	0.26	DNA	1.3	0.15[a]	0.0072	0.20	0.54	DNA
		PM_{10} (lb/lb metal)											
		Al	Hf	Zr	Fe	Mn	Pb						
	Avg	1.2	0.22	0.0078	0.25	0.60	DNA						
	N	3	2	3	3	3	DNA						
	SD	0.50	0.15[a]	0.0024	0.076	0.14	DNA						
		$PM_{2.5}$ (lb/lb metal)						Total PM (lb/lb metal)					
		Al	Hf	Zr	Fe	Mn	Pb	Al	Hf	Zr	Fe	Mn	Pb
V548 3 feet	Avg	6.9	DNA	DNA	0.11	0.44	1.5	45	DNA	DNA	1.4	5.6	13
	N	8	DNA	DNA	8	8	8	8	DNA	DNA	8	8	8
	SD	5.3	DNA	DNA	0.077	0.35	1.2	37	DNA	DNA	1.3	5.1	5.8
		PM_{10} (lb/lb metal)											
		Al	Hf	Zr	Fe	Mn	Pb						
	Avg	1.1	DNA	DNA	0.20	0.84	2.8						
	N	8	DNA	DNA	8	8	8						
	SD	0.57	DNA	DNA	0.10	0.45	1.4						

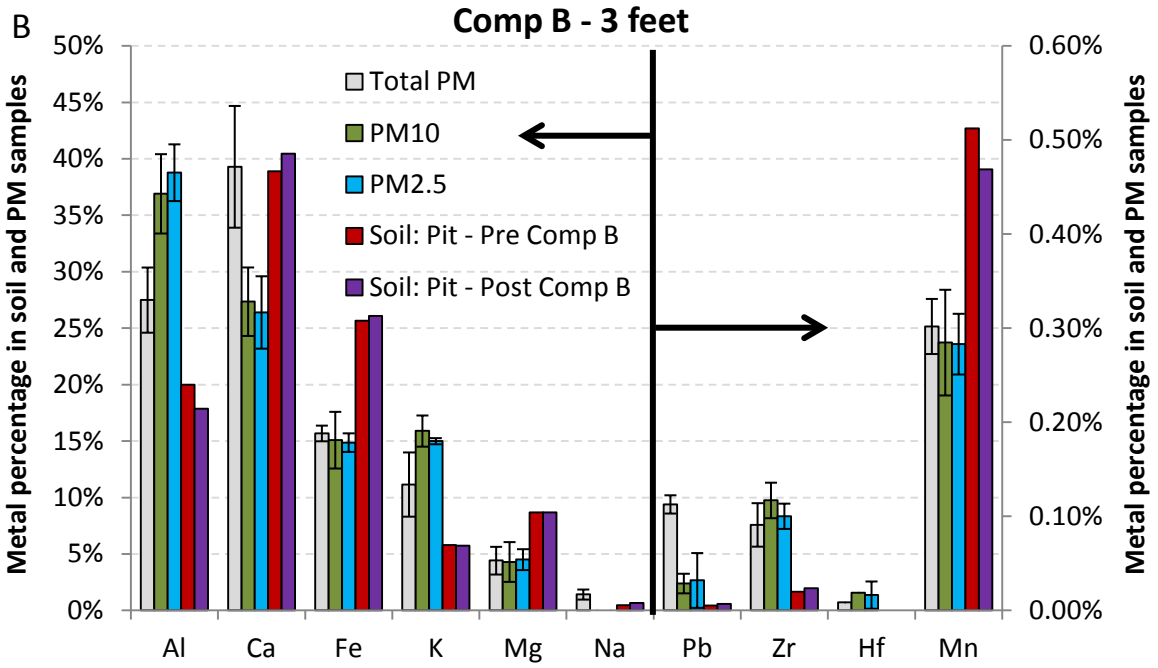
DNA, Does not apply; metal is not in ordnance composition. [a] Total PM results from PM_{10} impactor. [b] Absolute difference divided by two.

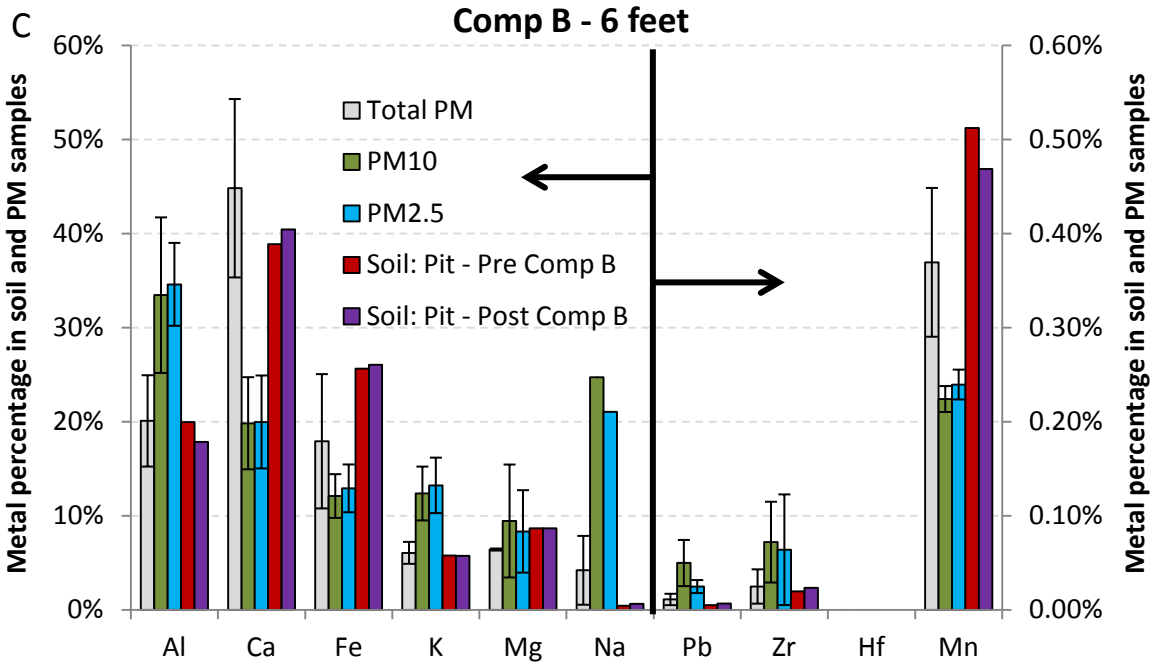
Table 3-8. Metal emission factors from ARC 451 and ARC 452A.

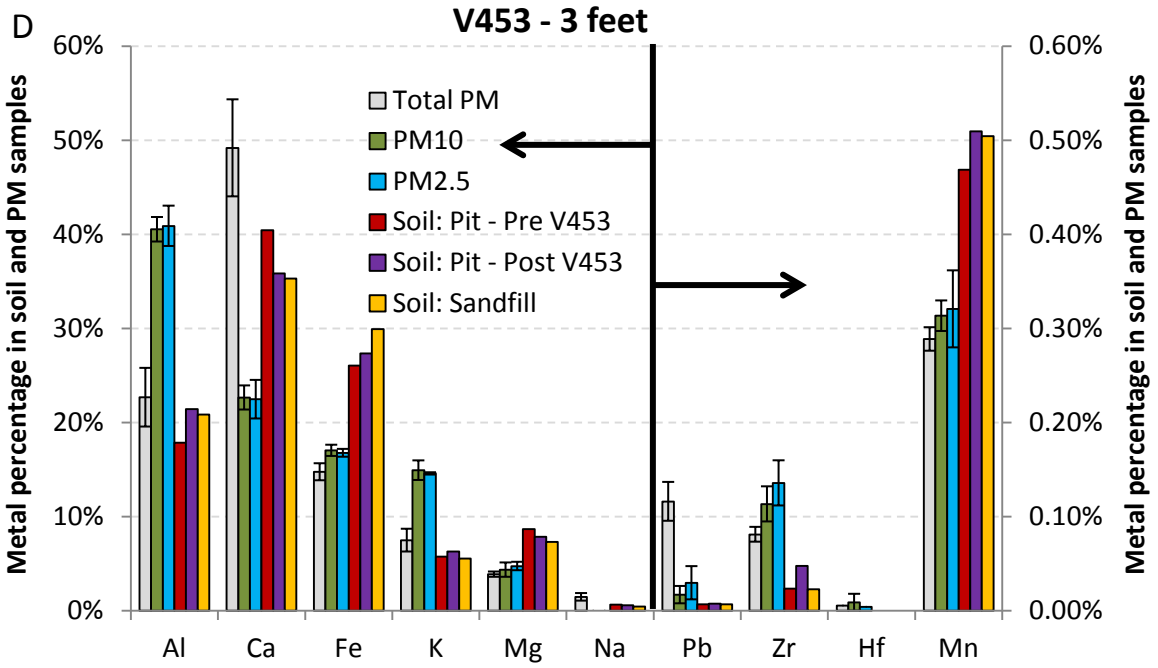
Propellant	$PM_{2.5}$ (lb/lb metal)		Total PM[a] (lb/lb metal)		PM_{10} (lb/lb metal)		Total PM[b] (lb/lb metal)	
	Al	Fe	Al	Fe	Al	Fe	Al	Fe
ARC 451	0.068	NA	0.069	NA	0.072	NA	0.073	NA
ARC 452A	NS	NS	NS	NS	0.100	0.110	0.101	0.389

NS, Not sampled; NA, not analyzed.
[a] Total PM from $PM_{2.5}$ impactor plate disk. [b] Total PM from PM_{10} impactor plate disk.

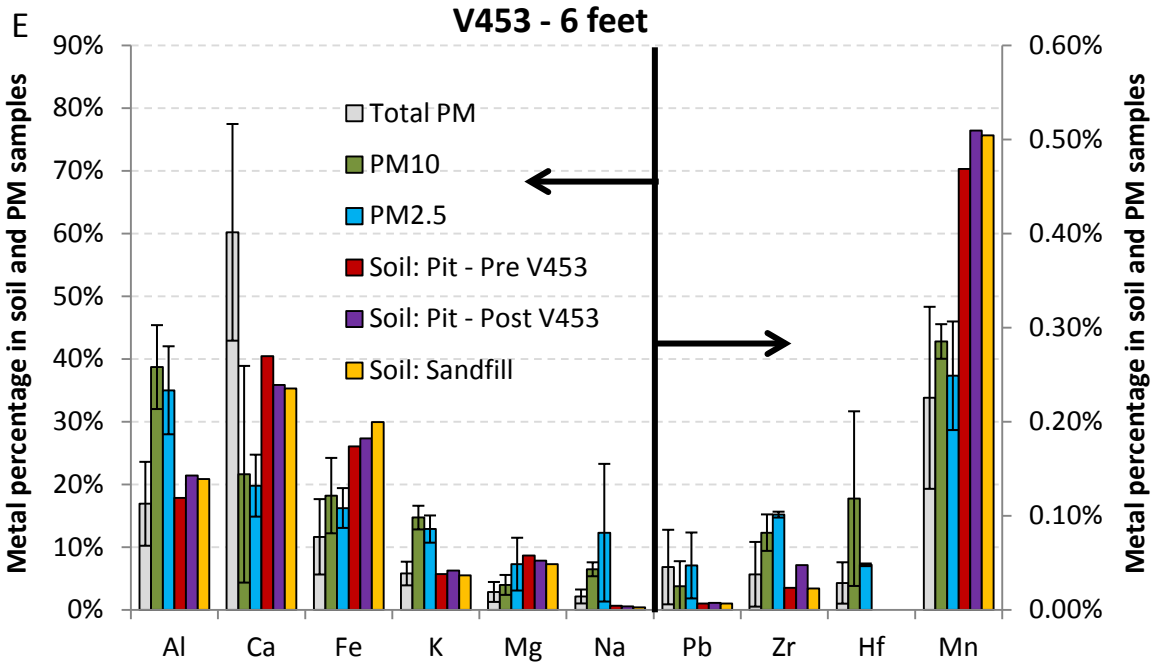

A
Comp B - Surface
Metal percentage in soil and PM samples
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit -Pre Comp B
Soil: Pit - Post Comp B
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn


B
Comp B - 3 feet
Metal percentage in soil and PM samples
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit - Pre Comp B
Soil: Pit - Post Comp B
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn

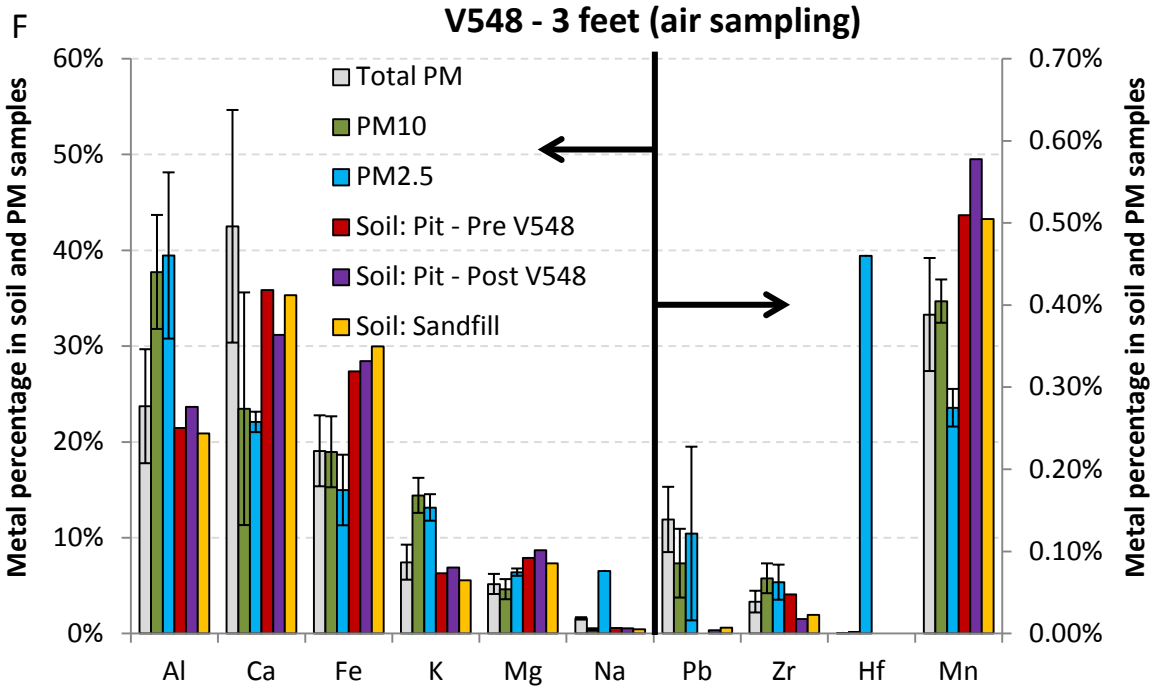

C
Comp B - 6 feet
Metal percentage in soil and PM samples
60%
50%
40%
30%
20%
10%
0%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit - Pre Comp B
Soil: Pit - Post Comp B
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn


D
V453 - 3 feet
Metal percentage in soil and PM samples
60%
50%
40%
30%
20%
10%
0%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit - Pre V453
Soil: Pit - Post V453
Soil: Sandfill
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn

E


V453 - 6 feet
Metal percentage in soil and PM samples
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit - Pre V453
Soil: Pit - Post V453
Soil: Sandfill
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn

F


V548 - 3 feet (air sampling)
Metal percentage in soil and PM samples
60%
50%
40%
30%
20%
10%
0%
0.70%
0.60%
0.50%
0.40%
0.30%
0.20%
0.10%
0.00%
Total PM
PM10
PM2.5
Soil: Pit - Pre V548
Soil: Pit - Post V548
Soil: Sandfill
Al
Ca
Fe
K
Mg
Na
Pb
Zr
Hf
Mn

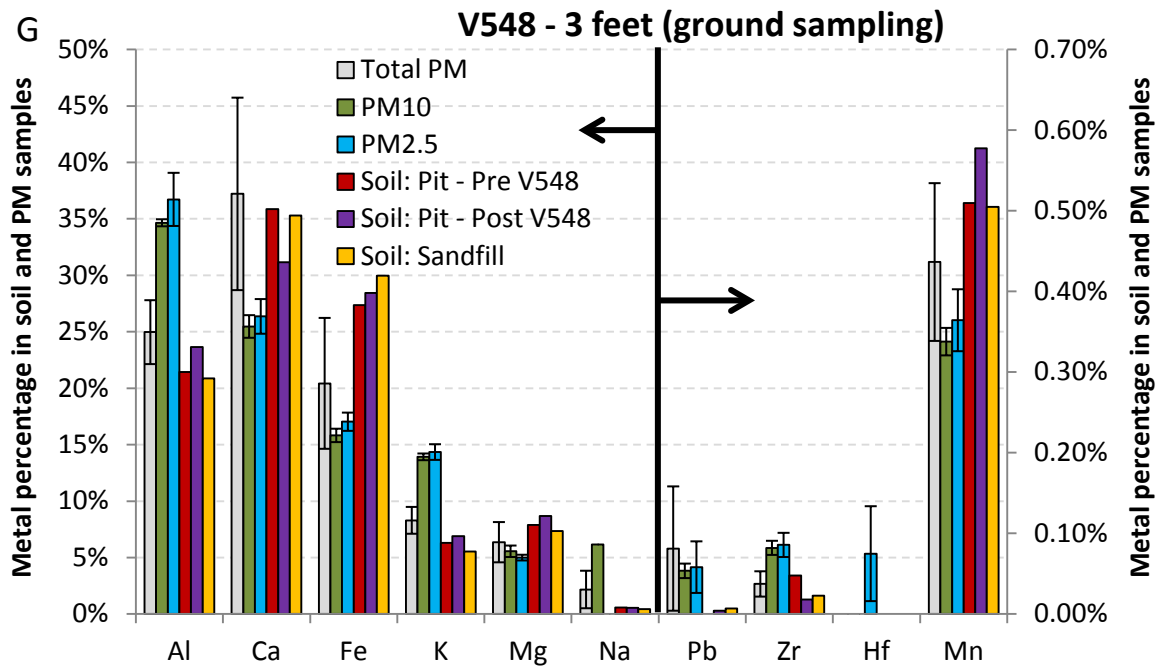


Figure 3-7. Metal percentage in PM and soil samples (A-G). Note two y-axes.

3.5 Continuous Particulate Matter

Continuous PM was measured by optical means with the DustTrak for six and three detonations of V453 and V548 (all munitions covered with 3 feet of soil) respectively; weight restrictions on the Flyer when adding the DustTrak sampler required removal of the SUMMA canister sampler to offset the weight gain thus limiting the number of samples. Many of the DustTrak measurements suffered from one or more of the optical PM channels being saturated (instrument saturation >150 mg/m^3). Only three of the detonations resulted in all PM channels less than 150 mg/m^3. The average cumulative mass distribution data for V453 (two detonations) and V548 (one detonation) showed that over half of the PM (58%) existed as PM_1:

- PM_{15} – 100%
- PM_{10} – 87% (± 11)
- Resp. (PM_4) – 63% (± 22)
- $PM_{2.5}$ – 59% (± 24)
- PM_1 – 58% (± 24)

Figure 3-8 shows time-synchronized photographs (first row), CO_2 and PM concentration traces (second row), and a repeat of these traces superimposed on the resultant Total PM emission factor (third row) for two representative detonations of V453 and V548. Five PM size classes are illustrated: PM_1, $PM_{2.5}$, PM_4 (Respirable), PM_{10}, and PM_{15}. The photographs and traces illustrate how the PM and CO_2 concentrations change throughout the plume history as it passes by the Flyer. The variation of the PM and CO_2 traces indicates both the heterogeneity of the plume as well as the ability of the crew to keep the Flyer in the plume. In the middle of the sampling for V453, both PM and CO_2 concentrations return to baseline ambient levels suggesting that the Flyer was not within the plume for this part of the plume passage. V548 data illustrate a more consistent plume sample and/or a better ability of the crew to maintain the sampler within the plume. The variation of the CO_2 traces with the PM measurements shows that PM is not necessarily associated with the CO_2. A number of instances were noted where the Flyer was within the visible plume (consisting of entrained soil, cover material, and detonation products) but elevated CO_2 concentrations were not observed, suggesting that the visual plume does not consistently contain detonation products. The degree of plume mixing and the position of the sampler (aerostat-based or ground-based) also appear to have an effect on the correlation between CO_2 and PM. The photo of the V548 detonation shows a very discrete plume (which was sampled at ground level due to high winds) as reflected in the distinct, uninterrupted CO_2 and PM peaks. The CO_2 peak is brief and is mostly correlated with the smaller PM fractions, suggesting that the gaseous combustion products are associated with fine combustion derived particles and/or fine soil particles. The V453 photograph shows a more dispersed plume that is in line with the more widely time-variant PM and CO_2 values observed in its accompanying CO_2 and PM trace graphs.

As mentioned above, the third row of Figure 3-8 shows PM and CO_2 concentrations versus their resultant PM emission factor. The PM emission factor is calculated, and non-zero, during those periods when the CO_2 concentration is distinctively greater than ambient levels, indicating the presence of the ordnance combustion products. The time-resolved $PM_{2.5}$ concentrations from six and three detonations were plotted against the corresponding concentrations of ΔCO_2 each second of the V453 and V548 detonation plume sampling, respectively (Figure 3-9). The correlation value indicates the degree of heterogeneity of the plume. The higher correlation for the aerial-collected sample (V453) than the ground-collected sample (V548) suggests that aerial measurements may allow for sampling a more homogeneous mixture of munitions-related pollutants than ground measurements. The correlations observed here between $PM_{2.5}$ and ΔCO_2, R^2 of 0.44 and 0.64, were lower than for open burns (the only other time these measurements were taken) of propellant shown in the 2011 study (WP-2153), of 0.77. This is not entirely unexpected as the open burns did not have the complication of soil entrainment into the plume nor the longer sampling distance required by the detonation hazard of rock and metal casing projectiles.

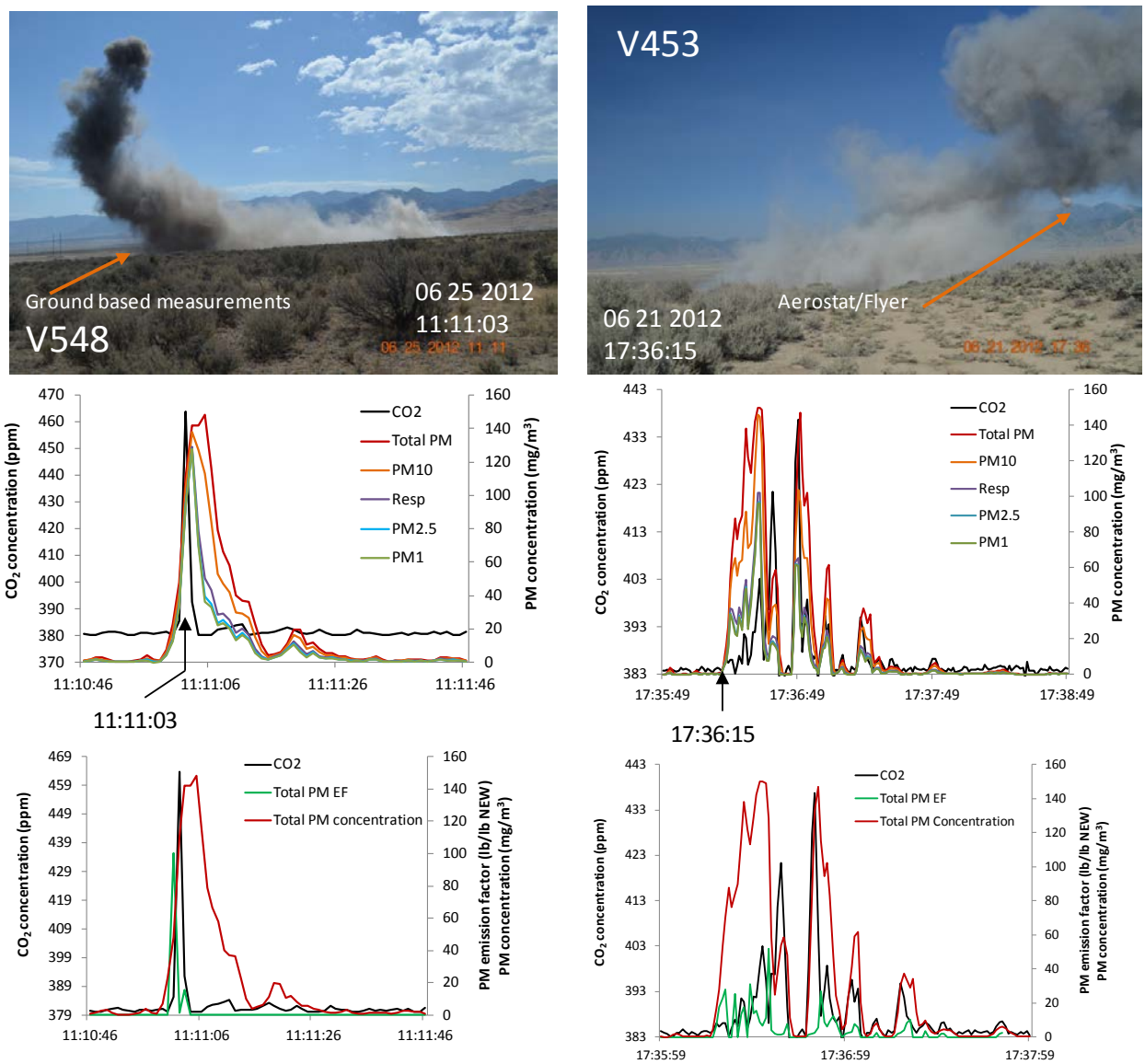


Figure 3-8. Segregation of CO_2 and PM in the plumes. Total PM and CO_2 concentration traces with instantaneous Total PM emission factors for V453 (first detonation) and 548 (second detonation) (both 3 ft soil cover).

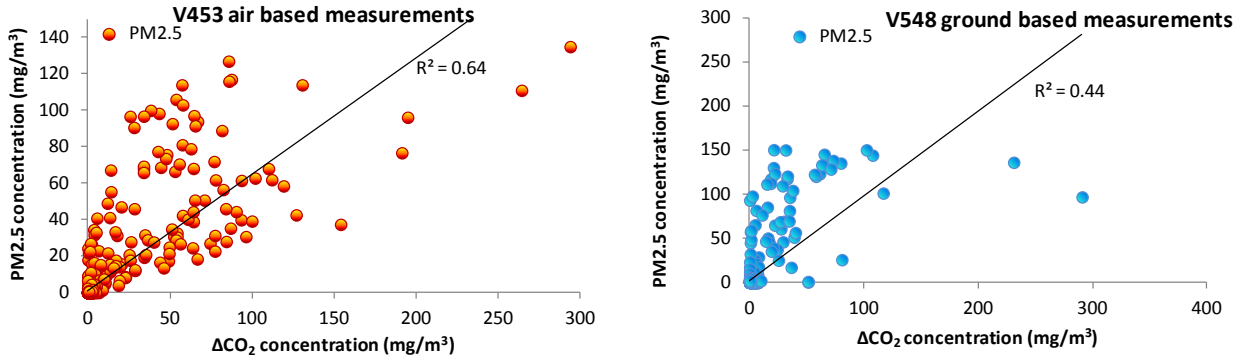


Figure 3-9. Correlations of continuous $PM_{2.5}$ and CO_2 concentration for six detonations of V453 covered with 3 feet of soil (air based measurements) and three V548 covered with 3 feet of soil (ground based measurements).

The PM is sampled throughout the whole duration of the plume and, depending on the heterogeneity of the plume, may be sampling soil/dust without any combustion products, such as CO_2. This would tend to raise the PM to CO_2 ratio, resulting in a higher PM emission factor. The variance of the PM emission factor throughout the plume passage indicates the heterogeneity of the plume, the need for cumulative measurements, and the benefit of multiple trials to arrive at a representative emission factor value.

The DustTrak-derived PM emission factors from the six detonations of V453 and three detonations of V548 are shown in Table 3-9. Overall these emission factors are much lower than the emission factors derived from contemporaneous, gravimetric measurements with the PM impactors shown in Table 3-6. There are several reasons for the much lower emission factors. One reason is that the light-scattering PM concentrations are only included in the emission factor calculations when the CO_2 concentrations are also distinctively above ambient, while the gravimetric impactor sampled throughout the whole duration of the plume without regard to the CO_2 level. Another reason is that the particle size range of approximately 0.1 to 15 µm for the light-scattering measurements was different that than of the PM gravimetric impact samplers, the latter which included all particles capable of passing into the impactor orifices. Finally the DustTrak measurements with saturated PM channels were not included in emission factor calculations and saturated PM channels indicate larger PM concentrations than the measurements without PM channel saturation.

A comparison of simultaneous sampling of PM_{10} and $PM_{2.5}$ by filter batch sampling and continuous light-scattering measurements is shown in Appendix F Table F16. These are the only series where there were overlapping measurements taken. This comparison shows that the filter measurements of emission factors are much higher than those from the DustTrak, for reasons explained above.

Table 3-9. PM emission factors derived from all DustTrak continuous light-scattering measurements.

			PM_{15} lb/lb NEW	PM_{10} lb/lb NEW	PM_4 lb/lb NEW	$PM_{2.5}$ lb/lb NEW	PM_1 lb/lb NEW
V453	**3 feet**	**Average**	5.3	4.2	2.3	2.1	2.0
		STDV	NA	0.98	1.2	1.2	1.2
		AD/2	NA	NA	NA	NA	NA
		N	1	3	6	6	6
V548	**3 feet**	**Average**	2.9	2.3	2.2	2.1	2.1
		STDV	NA	NA	1.2	1.2	1.2
		AD/2	NA	0.42	NA	NA	NA
		N	1	2	3	3	3

STDV, standard deviation; AD, absolute difference; N, number of samples.

Further evidence for both plume heterogeneity and morphology from detonation to detonation is observed in the photographs in Figure 3-10. Contrasting plume coloration, including surface soil (light color), soil cover (brown), and detonation products (dark) show the different components of the plume indicating significant heterogeneity of composition and particle density within a plume. Characterization of these plumes is therefore best pursued with multiple samples creating a composite value. The plume morphology also changes from detonation to detonation. Each of the photographs in Figure 3-10 are taken 7 seconds after detonation from V453, covered with 6 feet of soil, yet there is significant variation in the overall plume shape and character. This variation also translates into somewhat unpredictable plume transport paths, emphasizing the need for multiple samples.

Figure 3-10. Four detonations of V453 covered with 6 feet of soil, seven seconds after detonation.

3.6 HCl and Perchlorate

Perchlorate, chlorate, and HCl analytes were targeted for sampling from nine ammonium perchlorate burns of ARC 451 and four of ARC 452A burns (Table 2-3). Six composite Cl samples were analyzed, three according to the Alkali-impregnated filter ISO Method 21438-2 (International Standard, 2009) and three according to the Silica gel collection NIOSH Method 7903 (U.S. NIOSH, 1994). The results for both of these methods showed concentrations close to the method reporting limit, MRL (1.4 to 5 times the MRL) due to insufficient sample volume. This was the result of internal programming of the pump which caused the pump to cease sampling after 30 seconds. The operators were unaware of pump cessations until examination of the pump data post-campaign. After the pump shut down, its restart mechanism would not commence until 3 min had passed, by which time the bulk of the plume had passed. Subsequent troubleshooting after the field campaign found that the pump shuts off when the actual flow is less than that pre-specified by the user due to pressure drop across the filter. This “feature” was included in the Gillian pumps that were custom-configured for our remote operation and the standard manual did not include information about pump shut down during low flow rates. This shutoff was not anticipated based on 2011 Production Range tests with the Sparrow rocket motors because the plume sampling did not exceed 30 sec. As the pump was started about this same period of time prior to ignition, little of the plume is believed to have been sampled. Future tests

have added a pressure transducer to the pump system so that the operator will know when the pump is operating or not.

3.7 Comparing CO2 Measurements to OBODM Predictions

During the ARC propellant open burns and Cl species sampling, CO_2 and GPS-detected position and altitude were determined using two aerostats with the Flyer and a more lightly configured Flyer with a smaller aerostat (see photograph in Figure 2-12). The large and small aerostats were pre-positioned downwind approximately 80 and 120 meters and at an average altitude of 30 and 50 meters, respectively. The 80-120 meter downwind start location of the aerostats and their altitudes were changed slightly during the burn to ensure that they were optimally positioned within the plumes. Data for CO_2 concentration and position (downwind distance and altitude) were compared with predictions from the OBODM model (Bjorklund et. al, 1998). This model is used to produce input data of plume rise and concentration for use in the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) which is a general purpose standard USEPA dispersion/deposition model that is also used for munitions disposal health risk assessments. This work was undertaken by the USEPA participants as an in-kind contribution to the project. Significant effort was required to develop OBODM into a useful resource as the model is over 20 years old, was written in FORTRAN code, and was written to output results of cumulative exposure rather than concentration. In essence, a “shell” was written around the old OBODM code that allowed multiple runs to output a time series of concentrations. Initial results (see Figure 3-11 at t = 45 s) suggest reasonable agreement between the field measurements and model predictions, given the variation in local wind conditions. The top part of the figure shows a predicted, time-resolved ΔCO_2 concentration from the ARC propellant burns for the 13-run, averaged position of the large aerostat (solid line) and small aerostat (dashed line). The bottom figure shows the spatial ΔCO_2 concentration distribution at 45 s from OBODM and the model-predicted ΔCO_2 concentrations at the averaged aerostat positions (58.49 ppm for the large aerostat). For comparison, the 13-run, averaged ΔCO_2 value for the large aerostat (Table 3-2) during the 13 burns was 83 ppm. This measured value is higher than that predicted by OBODM’s large aerostat position at 45 s, suggesting that the plume was actually lower (and therefore the concentration was higher) than the OBODM model predicted.

A sensitivity analysis on OBODM varied the heat content of the munitions and localized wind speed. Higher heat contents increase the plume rise and decrease the downwind concentration due to higher buoyancy and an increase in the effective radius of the source. This led to an approximate uncertainty of 30% for the concentration at the small aerostat. Wind speed values, and the power law assumption for vertical variation of wind speed, make a large difference in the near-field OBODM plume predictions. This work has highlighted the need for local wind velocity measurements in order to accurately model plume characteristics with OBODM.

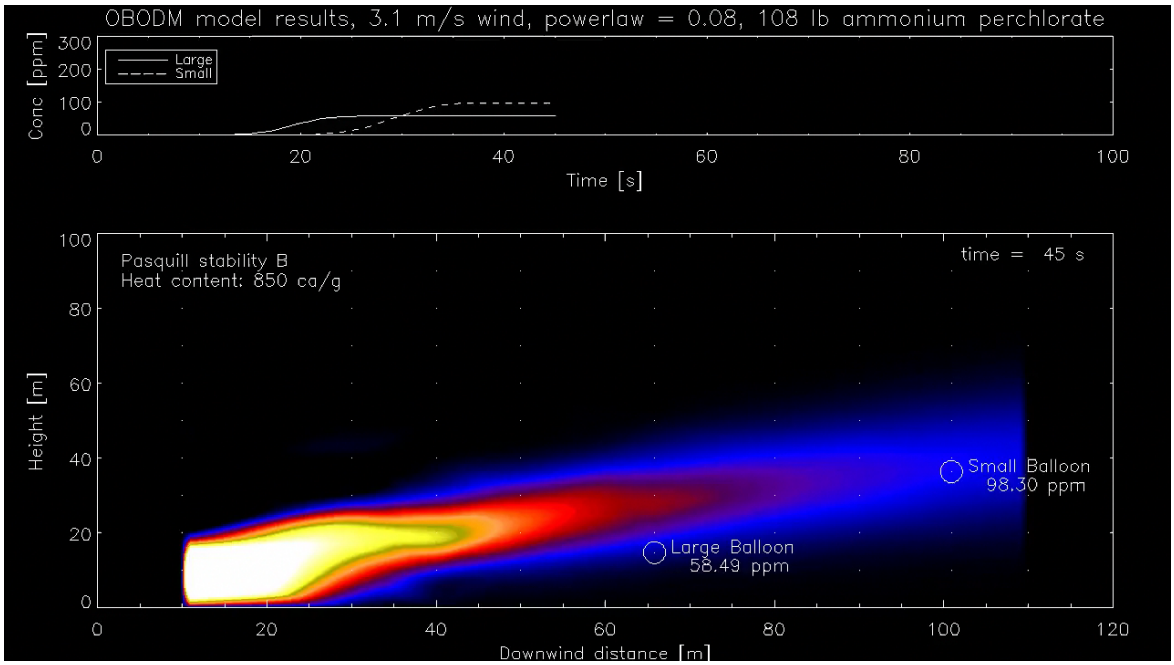


Figure 3-11.OBODM prediction of time-resolved CO_2 concentration from open burning of ARC-451 at the average location of the large and small aerostat-lofted samplers (Top). OBODM-predicted CO_2 concentration map at 45 seconds after ignition and predicted concentration at the average aerostat positions.

4. Conclusions

An aerostat-lofted emission sampler was employed successfully on 109 detonations of the bulk explosive Comp B and metal-cased V453 and V548 warheads. Open burning of AP-based propellant was undertaken in 13 sampling trials. Plume emissions, including VOCs, metals, energetics, and PM mass by particle size were characterized for determination of emission factors. This work represents the first emission sampling of soil-covered metal-cased ordnance detonations in the open atmosphere and determined the first $PM_{2.5}$ emission data for OD operations. The effect of surface detonations versus soil-covered detonations at two depths was evaluated. An exploratory trial of soil sampling to aid in partitioning PM emissions between the ordnance byproducts and soil entrainment/ejection was undertaken.

There was large variation between detonation events and within detonation plumes. Detonation plumes were heterogeneous in nature and could often be visibly divided by color between lighter areas that appeared to consist of mostly surface dust/soil cover, and darker areas that appeared to contain ordnance combustion products. In addition, the detonations themselves resulted in variable plume directions and morphologies. As a result of this variation, multiple detonations with cumulative samples are warranted in order to obtain representative samples and emission factor values.

Limited SUMMA canister samples detected VOC emissions of common BTEX compounds at part per thousand levels or lower. Benzene levels for soil-covered Comp B were similar to those from surface detonations of TNT conducted during work on WP-1672. VOCs for propellant burns were all below detection limits.

The fate of residual energetics after detonations was complicated by the presence of background TNT detected in limited soil grab samples at the test range's OD test area, the uncertain contribution of limited pre-test trial detonations to soil residues, test to test residual contributions, potential enrichment of emission samples having higher concentrations on smaller particles, the limited soil sampling conducted, possible contributions from the HMX-containing shock tube, and uncertainty as to whether the RDX formulation contained small amounts (4 to 15% by weight) of HMX.

Post-Comp B soil testing did not detect residual RDX, suggesting minimal transfer of energetics to the soil. Detonation of V453 and V548 does not support this conclusion, however, as substantial RDX and HMX, respectively, was found in the post-test soil. V548 also had the highest concentration of energetics for all the ordnance types, approximately 30 times that of the other munitions. This variation suggests that the fate of residual energetics (concentration, presence in soil or air) may be ordnance-specific or energetic-specific. The typical energetic emission factor was about 2E-06 lb/lb energetic.

Soil coverage of Comp B bulk explosive to 3 ft and 6 ft depths resulted in lower concentration ratios of soil energetics to plume PM energetics. However the emission factors for energetics

were higher for soil covered detonations. These results reflect soil-covered detonation that result in significantly higher amounts of PM entrained into the plume from the soil than surface detonations. Increased soil cover depth to 6 ft from 3 ft had an inconclusive effect due to the wide variance in results. Overall, ordnance soil coverage appears to result in higher energetic residuals in the plume on a carbon mass basis but this is based on limited testing.

The PM_{10} emission factor for the surface detonation of Comp B was in the same range as the surface detonation of TNT in the 2010 study (WP-1672), 0.29±0.13 lb/lb NEW and 0.13±0.07 lb/lb NEW, respectively. Buried detonations resulted in $PM_{2.5}$ and PM_{10} values ranging from 7 to 13 lb $PM_{2.5}$/lb NEW and 8 to 445 lb PM_{10}/lb NEW, respectively. The large increase in PM_{10} and $PM_{2.5}$ from surface to soil-covered detonation confirms that the latter results in significantly more soil mass in the plume.

Three methods of Total PM determination were evaluated that used related sampling systems to avoid adding the weight of a separate pump and hardware to the aerostat. Total PM sampled by the energetics filter, the PM_{10} impactor, and the $PM_{2.5}$ impactor resulted in soil-covered detonation emission factor values ranging from 23 to 156 lb PM/lb NEW, 51 to 476 lb PM/lb NEW, and 14 to 71 lb PM/lb NEW, respectively. The magnitude of these Total PM values underscores the very substantial contribution of soil to the plume PM mass. Total PM appeared to be significantly higher for covered rather than surface detonations, reaching a maximum of 476 lb/lb NEW, and did not appear to be affected by coverage depth. The range of values within each method is wide, indicating the heterogeneity of the plumes, a fact supported by plume photographs and time-resolved CO_2 and PM traces. The variable results were also likely a result of differences in the sampling methods. The energetic filter, oriented vertically facing the detonation source, was unlikely to hold onto larger particles and likely represents a low Total PM value. The $PM_{2.5}$ impactor had a lower Total PM loading than the PM_{10} impactor likely due to the smaller orifice size on the $PM_{2.5}$ inlet (8 holes of 1.7 mm [0.07 in] diameter versus 8 holes of 4.3 mm [0.17 in] diameter on the PM_{10} impactor) limiting the capture of large particles. Total PM from the PM_{10} impactor seems the most reliable of the three methods since it was not limited in collecting larger particles; this should be verified by parallel tests with a dedicated Total PM sampler. The large, loose particles present in some of the PM_{10} impactors suggest also that the extremely high particle loading in the plume may have overloaded the impactor plates. Future tests should examine this issue by employing a pre-separation mechanism, such as a cyclone, prior to the impactor plate.

Clear discernment of the fate of ordnance metals suffered the same limitations as the energetics. Residuals from historical testing of explosives on the range, limited soil sampling, test to test residual contributions, and the potential for biased plume collection of enriched metals on smaller particles resulted in uncertainty in partitioning between soil and direct emissions from the munitions. The presence of Zr and Hf in select ordnance and their presumed absence in the soil afforded an attempt to follow the metals' fates. Trace amounts of Zr in the soil were increased 4-fold in the Comp B emissions (although Comp B does not include Zr), demonstrating possible enrichment by particle size and the inadequacy of bulk soil samples for characterizing metal con-

centrations in soil PM. The same phenomenon was observed with Hf which was not detectable in the soil but became detectable in the Comp B PM emissions, even though it was not present in Comp B.

All of the PM samples from the V453 detonations resulted in emission factors (lb Hf or lb Zr mass/lb metal in the munition) less than or equal to 0.22 or 22%, meaning that most of the metal in the munition does not end up in the emissions, despite the potential contribution of Hf and Zr from the soil. For $PM_{2.5}$ and PM_{10}, the average Zr emission factor was 0.006 lb Zr/lb metal, meaning that less than 1% of the metal in the ordnance ended up in the emissions. For Hf this value was 8.2%. These results are not unexpected since the metals are part of an alloy comprising a shaped charge within the munition and it is unlikely that all of this material would be reduced to PM_{10} or smaller particles. Both propellants resulted in metal emissions in the PM samples. From single composite samples, ARC 451 and ARC 452A had about 7% and 10%, respectively of their Al emitted into the plume based on PM sampling. Results for Fe show a greater range, between 10% and 39%. Additional tests should be conducted to verify these single-sample results.

Sampling of AP-containing propellant for Cl species was inconclusive as the sampling pumps turned off after 30 s, collecting an insufficient sample size to exceed detection limits. Additional tests should be conducted to determine air emissions of Cl species resulting from Open Burning of such AP-based propellants.

Simultaneous collection of CO_2 and position data with two aerostat/Flyer pairs enabled preliminary evaluation of the OBODM model, highlighting the sensitivity of model results to local wind speed. Additional detailed testing and evaluation could be performed to more fully evaluate the OBODM outputs versus actual air emission concentrations.

All test plans and reports have been provided to the Joint Ordnance Commanders Group Demil Subgroup Chairman for appropriate coordination within DoD and USEPA as dictated in the Open Burning Open Detonation Emissions Factor Protocol (Joint Conventional Ammunition Policy and Procedure #7). Data obtained from this study and WP-1672 and WP-2153 will greatly assist DoD in performing health risk assessments and obtaining permits for their OB/OD operations. Overall, the study was successful in determining the feasibility of the deployed measurement systems. The field campaigns and data analysis results clearly indicated that some of the measurement systems can become powerful tools to characterize air emissions from field OB/OD operations.

Results from this project combined with results from WP-1672 and WP-2153:

- Provided DoD with feasible open atmospheric methods to obtain accurate air emissions data for OB/OD operations,
- Provided DoD with some preliminary information with which to evaluate the practice of soil coverage for OD,

- Provided DoD with much needed emission factors and data of a very high quality according to USEPA requirements,
- Helped DoD during discussions with USEPA to formulate accurate and representative air emission factors for eventual publication with USEPA.

5. Recommendations

Repeat detonations under identical conditions resulted in large variation in the appearance of the resulting plumes. This visual evidence reinforces the need for collecting composite plume samples across multiple trials and for continuing this level of sampling in future testing. This study conducted only limited numbers of trials using developmental sampling methods. Although a great deal was achieved during this work, additional tests should be conducted in order to validate the sampling methods and develop well-substantiated and representative emission factors for OD.

The following suggested additional tests would help confirm and enhance results from work on WP-2233:

- Limited data showed higher than expected CO levels in some OD plumes up to about 100 ppm. These results should be confirmed with additional tests.
- Based on the large variations and observed sampling problems with the $PM_{2.5}$ and PM_{10} impactors, additional testing is needed to obtain more substantiated emission factors. Testing of PM air emissions from covered detonations should include comparisons to uncovered detonations, PM size distribution analysis, and evaluation of contributing factors such as cover depth, soil moisture content, and soil types.
- Additional testing should be performed to evaluate the impacts of soil coverage, energetic type, and munition design (e.g., bulk vs. cased, casing material, and casing thickness) on direct energetic air emissions from munitions and contributions from the soil.
- Additional testing should be conducted to evaluate metal air emissions from cased munitions. The results showing the fate of ordnance-specific metals should be further explored to understand, for example, the fate and element-specific partitioning of Hf and Zr in the emissions. To avoid potential test to test carryover of metals, successive detonations should be carried out in distinctive sites with a consistent soil cover of known composition.

The following suggested modifications to test and sampling methods are made based on field campaign work on WP-2233:

- The success at maneuvering the aerostat into the plume via remote control winches can be improved by attaching a real-time camera feed on the aerostat.
- Limited tests were conducted here for VOCs due to weight limitations on the sampling system. Lighter systems can be designed for long-term, whole plume sampling.
- Future methods to obtain PM emission factors should account for likely overload conditions on impactor plates through incorporation of a pre-impactor such as a cyclone. Additional test-

ing with parallel PM samplers, one being a dedicated Total PM sampler, will be necessary to verify the methods combining $PM_{2.5/10}$ impactors and Total PM measurements.

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Appendix A: USEPA Quality Assurance Project Plan

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Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance

Quality Assurance Project Plan
Category IV / Proof of Concept

Revision 0.1

Work Assignment 0-52

January 2010

ARCADIS

Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance

Quality Assurance Project Plan
Category IV / Proof of Concept
Revision 0.1

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1. Project Description and Objectives

This Quality Assurance Project Plan (QAPP) provides guidance to personnel conducting emission testing under the U.S. Environmental Protection Agency (EPA) Work Assignment (WA) entitled *"Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance"*, Contract Number EP-C-09-027, WA Number 0-52, Project Number RN99270.0052. This work is funded in part by an Intergovernmental Agreement (IA) which provides funding through the Strategic Environmental Research and Development Program (SERDP).

This WA is designed to develop and apply methods for sampling Open Burning/Open Detonation (OB/OD) of military ordnance in the field to characterize gaseous and particulate matter (PM) emissions for determination of emission factors of various target compounds. This project will use a novel measurement approach consisting of an aerial, balloon-borne instrument developed by EPA ("The Flyer").

This document covers in detail the background, objectives, technical approach, quality assurance (QA), and quality control (QC) aspects of data collection and analysis.

1.1 Background

U.S. Department of Defense (DOD) Installations, especially demilitarization facilities and Army Ammunition Plants (AAPs), have used Open Burning/Open Detonation *(OB/OD)* for a long time as a safe and economic means to dispose of propellants, explosives, and munitions. DOD installations are required to comply with the Resource Conservation and Recovery Act (RCRA) to operate *OB/OD* facilities. RCRA permits provide annual limits on the amount of energetic materials that can be disposed of at *OB/OD* facilities. The permit limitations are based on human health risk assessments that include risk estimates from airborne exposure to pollutants generated from *OB/OD*. These assessments use emission factors developed mostly from a limited number of tests on small scale *OB/OD* chambers, known as the "BangBox", and large scale open range detonation and burn tests. There is continued need, however, to further develop methods of sampling these events to add to, and support, current data.

1.2 Objectives

This project has two objectives, both method development and measurement of source emission factors. These will be pursued through development and testing of the "Flyer" as a measurement and sample collection device with field application to measurement of emission factors from OB/OD.

1.2.1 Method Development for the Flyer

The Flyer is a lightweight platform that is intended to support sampling, CEM, and data logging capabilities while being lofted by a tethered balloon within the downwind plume evolving from some burn or detonation event. Figure 1-1 illustrates the Flyer in an initial configuration. As presented in this figure, it is configured

with battery, pumps, non-dispersive infrared (NDIR) carbon dioxide CEM, PM sampling by filter, polyurethane foam (PUF) cartridge for semi-volatile organics, and a data logger for CO_2, flow, and temperature data. Figure 1-2 illustrates the Flyer in operation, lofted by a tethered balloon. The two all-terrain vehicles (ATVs) with tether connections permit controlled positioning of the flyer within the plume. Global positioning system (GPS) measurements will be used to determine the position of the Flyer (altitude, coordinates) relative to the OB/OD event.

1.2.2 Measurement of Emission Factors

For the purposes of the planned measurements under this project, the Flyer will be configured with a carbon dioxide CEM; Summa canister for VOCs, PUF/XAD-2 resin/PUF sampler for semi-volatile organics, and filter for particulate matter and metals determination. A small GPS will be mounted on the Flyer for monitoring its location. Additionally, sophisticated electronics using the CO_2 signal will be used to "trigger" sampling events by opening sampling valves and initiating sampling pumps. The ratio of the selected target analyte pollutants to that of the CO_2 will determine emissions factors based on carbon. With knowledge of the C composition in the ordnance and the assumption of complete C oxidation, a pollutant emission factor per mass of the original ordnance can be determined.

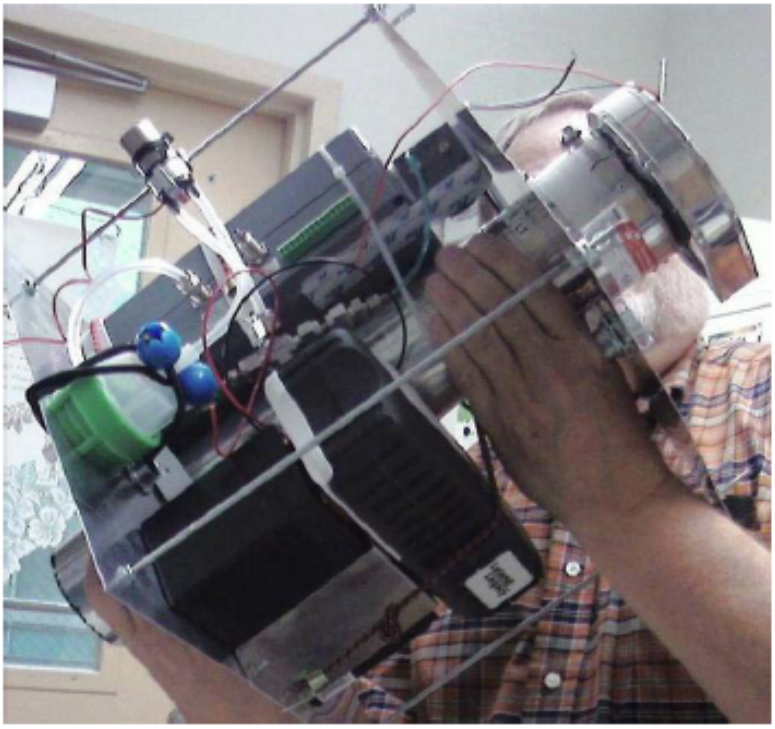

Figure 1-1. Flyer, Version 1

Figure 1-2. Lofted Flyer with ATV Positioning

1.3 Project Schedule

1.3.1 In-House Flyer Test Development and Target Compound Detection Limits

Trial runs will be performed at the EPA (RTP) facility to test the "Flyer" operability and determination of the target compounds detection limits. Two preliminary tests will be performed in RTP to satisfy these needs prior to the initiation of the field sampling campaign. These will consist of a burn hut test in January (preliminary schedule) in which the Flyer will be suspended and operated in the enclosed burn hut during a combustion test. The primary purpose of this test is to examine the hardware functioning such as the concentration-triggered sampling valves. The second test will consist of an actual sampling event with the Flyer lofted in the plume from a forest fire or sampling ambient air mimicking the actual OB/OD test. This

test will examine any hardware modifications resulting from the burn hut test and collect samples that will be used to examine detection limits. None of these data are intended for publication.

Preliminary tests are being done on sorbent contamination levels, ambient air levels of target analytes from proposed sampling media, and breakthrough tests. This will also include spike testing of Summa canisters.

1.3.2 Field Measurements

The balloon-lofted Flyer will be used to collect data and samples during the open burn (OB) and open detonation (OD) of military ordnance at the Tooele Army Depot, Tooele County, Utah in March of 2010. Figure 1-3 provides a map of the area.

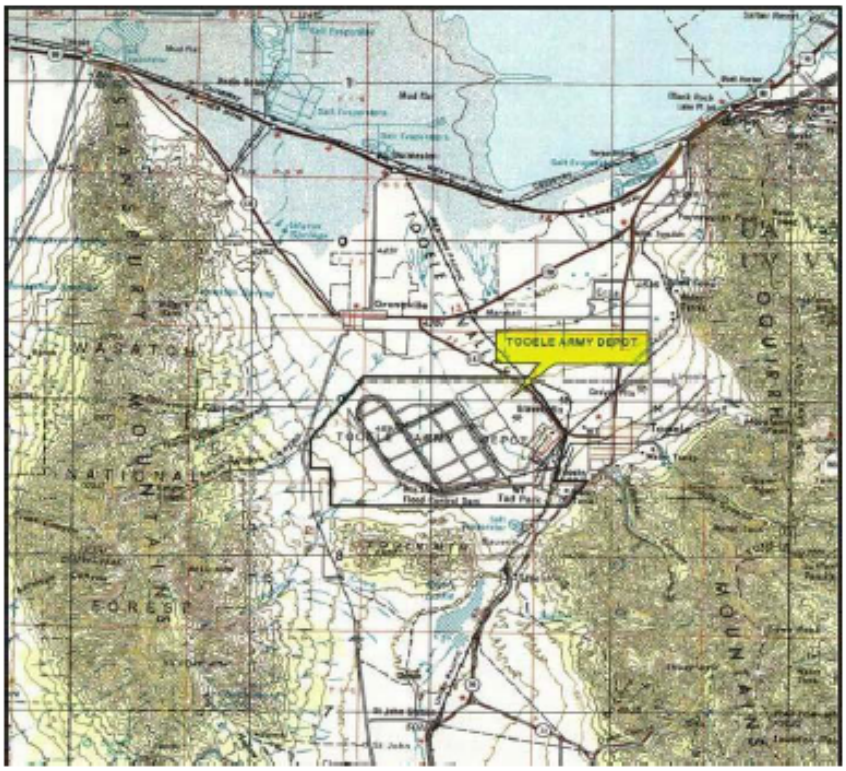

Figure 1-3. Map Locating Tooele Army Depot

Figure 1-4, supplied by Tooele Army Depot, provides a close-up map of the Test Range which consists of an indoor facility (#1376), bunkers, a gravel/sand detonation test range (~100×50 meter, small gray

rectangle), and a concrete burn pad (~20 x ~25 m, inside the small red and green circles) for open burning tests. The Army determined several initial safety stand-off scenarios as a function of charge size and plotted these on Figure 1-4. The OB and the OD tests are video monitored and recorded from the indoor facility/bunker (#1376) on Figure 1-4. The green solid line broken by green "x's" is a fence in which five gates will be installed for repositioning instruments. The elevation at the Tooele test range is about 5500 feet above sea level.

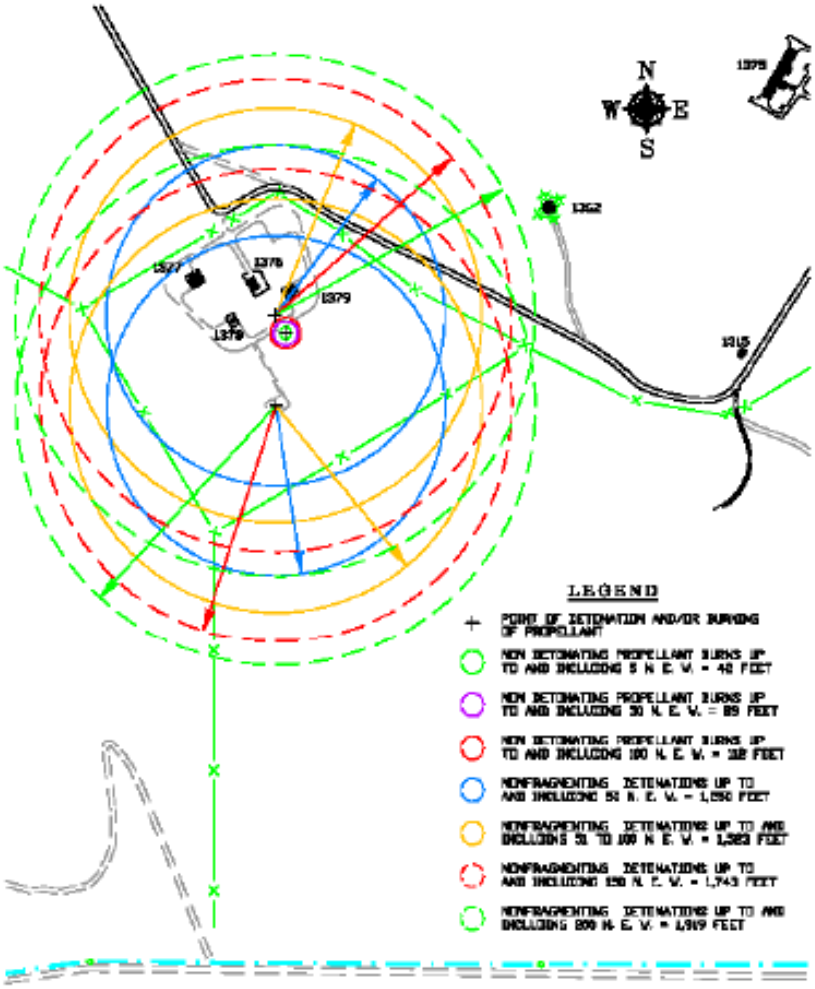

Figure 1-4. Tooele Test Facility Map

In order to predict instrument locations for optimal sampling, meteorological data such as wind speed, wind direction, and temperature will be collected from the Salt Lake City National Weather Service,

www.noaa.gov, and www.accuweather.com, which gives an hourly forecast. Additional ground level data on wind speed, wind direction, cloud cover percentage, ceiling, precipitation percentage, thunderstorm percentage, clearing index, visibility, and winds aloft will also be collected from two meteorological stations located at the Army Depot. These data are available on a daily basis from Brian Wakefield, TEAD Ammunition Production Controller, brian.j.wakefield@us.army.mil, DSN 790-5134, Commercial 435-833-2621. The weather forecast and the actual weather conditions have been shown to be in good agreement. The wind direction is mostly stable in the mornings and in the afternoons while during midday the winds are unstable i.e., fast changes in the wind direction. The predominant wind direction in the morning is from the south-southwest and shifts to the north-northwest in the afternoon. During the month of March the temperature is between 20 to 60 °F (-6 to 16°C). The Army Depot local wind data will be used to calculate the sampling module positioning in addition to personnel safety. The maximum allowed wind speed for performing the detonations and burns are 15 MPH (6.7 m/s) with gusts up to 25 MPH (11 m/s). In addition, the minimum visibilities for detonations are 1 mile with not less than 2,000 ft of ceiling (cloud cover) for detonations.

The proposed test matrix and schedule in this program are subject to changes in time and scope by the EPA WA Manager due to budget constraints or facility approval. Table 1-1 details the proposed schedule for this project.

Table 1-1. Test Schedule

Task	Start Date	Planned Completion
QAPP	December 20, 2009	January 15, 2010
In-House Flyer Test Development and Target Compounds Detection Limits	January 15, 2010	February 26, 2010
Tooele Sampling Campaign	March 8, 2010 (site preparation) and March 15 (actual sampling)	March 26, 2010
Data Analysis and Reporting		Upon Availability of the data

2. Project Organization

The organizational chart for this project is shown in Figure 2-1. The roles and responsibilities of the project personnel are discussed in the following paragraphs. In addition, contact information is also provided.

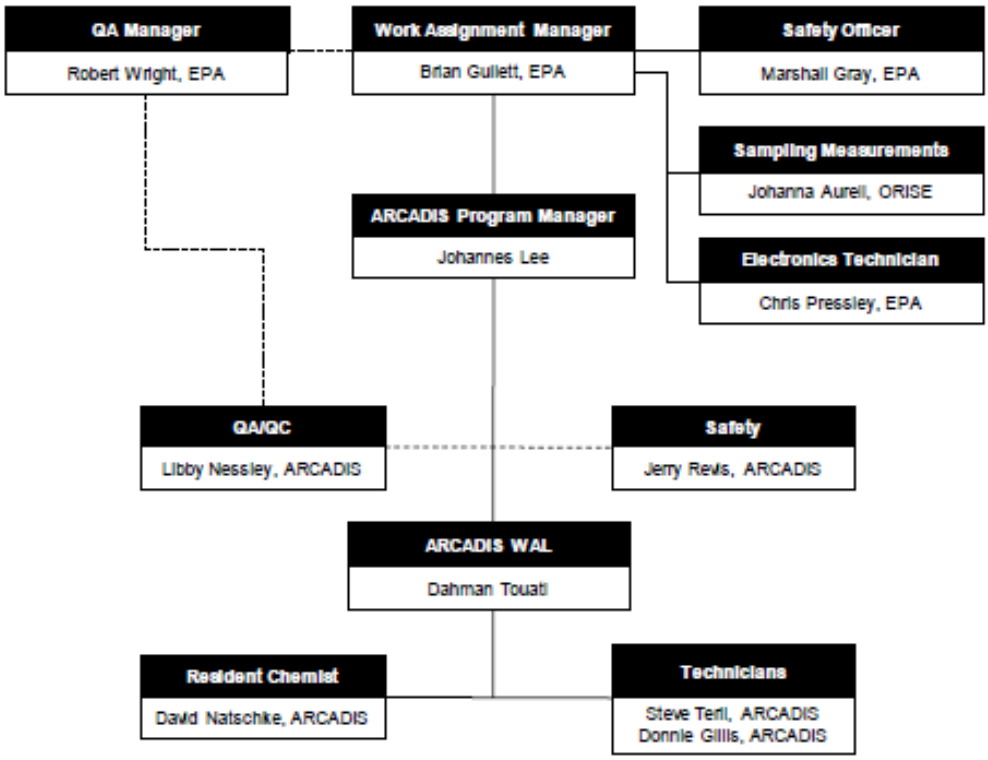

Figure 2-1. Organization Chart

EPA WA Manager (WAM), Dr. Brian Gullett: Dr. Gullett has overall project responsibility. He will direct the project's technical aspects and will be responsible for maintaining project budgets. Dr. Gullett will coordinate with EPA Quality Assurance (QA), EPA management, and with the ARCADIS WA Leader (WAL). He will schedule meetings with the ARCADIS WAL to discuss issues related to the work assignment and the necessary corrective actions to be taken. He has the authority to request a stop work order be placed on the work assignment by the Contract Officer for safety or quality control reasons.

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EPA QA Representative, Robert Wright: The EPA QA Representative will be responsible for reviewing and approving this QAPP. In addition, this project is subject to audits by EPA QA. Mr. Wright is responsible for coordinating any EPA audits.

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EPA Electronics Technician, Chris Pressley: Mr. Pressley will be responsible for Flyer instrument wiring and connections, and data logging.

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Post-doctoral Fellow of National Research Council, Dr. Johanna Aurell: Dr. Aurell will be helping Dr. Gullett for all the technical aspects of the projects, including the design of the test matrix, participation in the sampling campaign, and data reporting at the discretion of the EPA WAM. Dr. Aurell will be responsible for sampling and data collection.

Phone: 919.541.5355
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EPA Organic Laboratory Manager, Dennis Tabor: Mr. Tabor will be responsible for the analytical work associated with the project. Mr. Tabor will review any samples sent to an outside laboratory for data quality measures and review subsequent laboratory analytical reports.

Phone: 919.541.2686
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ARCADIS WAL, Dr. Dahman Touati: The ARCADIS WAL is responsible for preparing project deliverables and managing the WA. He will assist in analytical data reduction, validation, and reporting. He will ensure the project meets scheduled milestones and stays within the budgetary constraints agreed upon by EPA. The WAL is responsible for communicating any delays in scheduling or changes in cost to the EPA WA Manager as soon as possible.

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ARCADIS QA Officer, Laura Nessley: The ARCADIS QA Officer is responsible for reviewing and approving any data analyses conducted by ARCADIS. Any report prepared for EPA will be reviewed by Ms. Nessley and at least 10% of the calculations will be verified with the raw data sheets, notebooks, etc.

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ARCADIS Safety Officer, Jerry Revis: Mr. Revis will be responsible for ensuring that this project is carried out in accordance with all permit and EPA safety requirements. He will also ensure that anyone working on the project has fulfilled all of the safety training requirements.

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3. Experimental Approach

3.1 Sampling Approach

The purpose of the planned Tooele Army Depot sampling is to demonstrate the Flyer sampling technology for determination of emission factors from OB/OD of military ordnance. This will be accomplished by collecting plume samples to calculate concentration data for selected analytes. A limited set of target analytes, selected from those for which emission factors exist and for which there is a reasonable degree of confidence, is sufficient to satisfy the technology demonstration purposes of this project. The target analytes for this project will be benzene, naphthalene, lead, and total particulate matter. These analytes represent a range of anticipated OB/OD products and, hence, represent a broad range of sampling methods/equipment. The VOC, semi-volatile, and filter samples will be analyzed to calculate concentrations for these analytes. The CO_2 CEM data will be used to calculate a co-sampled carbon concentration, which will permit conversion of analyte concentrations to emission factors by a carbon balance method. In this method, the ratio of the sampled target analyte concentration to the total sampled carbon (as CO_2) is related back to the initial ordnance weight through knowledge of the carbon concentration in the original ordnance and the assumption of 100% oxidation of the carbon.

The Flyer, Figure 1-1, is a loftable, instrument-bearing platform for the collection of batch gas and particle samples from ambient air or plumes, the collection of CO_2 via continuous emission monitors, and the logging of data. It includes programmable logic control hardware that may, for example, enable sampling only when CEM data indicates that the Flyer is located within a plume. Power for the instruments is provided by replaceable, rechargeable battery sources. Previous work has shown that the mass of the Flyer (ca. 10 kg) is within the lofting capabilities (~15 kg at sea level) of the Kingfisher (K13N) 13×10.3 foot-diameter helium balloon, Figure 1-2. The balloon is tethered using Spectra line to a pair of ATVs equipped with electrically powered winches. The combination of two ATVs and two tethers permit the positioning of the balloon, and therefore the Flyer, at a specific location and height downwind of a source. Calculations from wind direction and speed permit calculation of the target location and elevation. A third potential tether and winch will be used to provide a third, vertical dimension for the Flyer below the balloon, if necessary.

As described in section 1.2.1, the Flyer is being configured for this project with a carbon dioxide CEM, VOC sampler with a Summa canister, semi-volatile sampling with a sandwiched PUF/XAD-2/PUF sampler, particulate sampling by filter, and temperature plus relative humidity using a HOBO (U12-013) sensor with data logging. CEM data are logged to an on-board HOBO U12-006 unit.

During the March sampling campaign, samples will be collected from both OB and OD of M1 propellant and trinitrotoluene (TNT), respectively. Table 3-1 provides the composition of these materials, while Table 3-2 provides available emission factors for the target analytes.

Table 3-1. Composition of OB and OD Ordnance

Material	Mass %	Composition	
M1	84	Nitrocellulose	$C_6H_7(NO_2)_3O_5$
	9	2,4-dinitrotoluen (DNT)	$C_6H_3(CH_3)(NO_2)_2$
	5	Dibutyl phthalate (plasticizer)	$C_{16}H_{22}O_4$
	1	Diphenylamine	$(C_6H_5)_2NH$
	1	Lead carbonate	$PbCO_3$
TNT	100	Trinitrotoluene	$C_7H_5N_3O_6$

Table 3-2. Emission Factors

Analyte	Units	TNT, OD	M1 propellant, OB
CO_2	lb/lb C	3.5	3.6
Naphthalene	lb/lb NEW	$1.3\ 10^{-5}$	$1.9\ 10^{-8}$
Pb	lb/lb NEW	NA	0.0078†
PM_{10}	lb/lb NEW	7.2	0.0069
Benzene	lb/lb C	$2.6\ 10^{-4}$	$1.4\ 10^{-5}$

lb/lb C pound per pound carbon
lb/lb NEW pound per pound net explosive weight
NA not available
† Calculated from Table 3-1 composition data assuming 100% release
Source: AP-42 (2009).

Sampling will occur after each of single or multiple (in series) open burns and open detonations. Multiple burns or detonations may be necessary in order sample enough of the target analytes to exceed method detection limits or background levels while keeping the charge size sufficiently small that our safety stand-off distance doesn't preclude adequate concentrations. This single, composite sample will be created by reusing the same sorbent media during multiple burns or detonations. The number of burns or detonations necessary to obtain sufficient sample will be determined by pre-test, CO_2-only measurement trials during the week of March 8th designed to understand what level of pollutants can be anticipated and at what rate from a single OB and single OD trial test. The CO_2 concentration will be used as a surrogate measure of the plume's pollutant concentration. For some target analytes (e.g., naphthalene), it is likely that multiple burns or detonations in series will be necessary in order to create a single sample that exceeds detection limits. It is almost certain that OD will be sampled after serial detonations in order to achieve higher pollutant concentrations; OB is less certain to be in series as sufficient concentrations for all target analytes may be observed during single burn tests.

For each of the OB and OD scenarios, a five day sampling campaign, with morning and afternoon test series, is planned. For the first week, five days of morning and afternoon tests will result in nine OB series (the first day will include background sampling and one test series) each of which may include multiple test burns. Similarly, the second week will result in five days of morning and afternoon OD series for a total of nine series. For each critical analyte, five replicate samples will be the project goal, although more are desirable. Each target analyte is measured by a different instrument that can be moved on or off the Flyer as needed. The number of analytes that can be sampled simultaneously will be determined by instrument weight restrictions, battery life considerations, and Flyer performance. Hence, the maximum number of tests that a single analyte will be sampled is nine for OB and nine for OD, plus background and blank samples. The minimum desirable tests for a single analyte is five for OB and five for OD, plus background and blank samples.

3.2 Analytes and Process Measurements

The following list describes the critical measurements:

Benzene
Naphthalene
Carbon dioxide
Total solid particulate
Lead
Sampling flow rates

Table 3-3 presents the planned sampling and analysis methods

Table 3-3. Sampling and Analysis Methods

Target Compound	Sampling Method	Sampling Rate	Analysis
Benzene	TO-15 Summa	0.6-3 L/min	GC/LRMS
Naphthalene	TO-15, Summa	0.6-3 L/min	GC/LRMS
Naphthalene	Modified TO-13, PUF/XAD-2/PUF	250 L/min.	GC/LRMS
PM	Filter	15 L/min	Analytical Balance
Lead	Filter	15 L/min	Compendium Method IO-3.3, EDXRF
Carbon dioxide	CEM	Every second	NDIR CEM
Carbon dioxide	EPA Method 25C, Summa	0.6-3 L/min	GC
Temperature	Thermistor, variable resistor	Every second	HOBO U12-013
Relative humidity	Electronic sensor	Every second	HOBO U12-013
Flowrate	Differential pressure venture	Every second	HOBO U12-013

3.3 Test Specific Sampling Procedures

3.3.1 Open Burning

The balloon and Flyer will be prepositioned downwind of the burn site with the aid of small release balloons and smoke grenades. Two ATVs with electric winches and tethers will be used to anchor and maneuver the balloon. The ATVs and the balloon, as well as all personnel, will be located outside the safety stand-off distance. Each ATV will have a driver. If a vertical tether is used, the third tether will also have an attendant. The M1 propellant will be ignited and the ATVs will be adjusted to maneuver the balloon into the plume, guided by binocular-aided visual observation and a high visibility light which is activated by a CO_2 level trigger.

Optimal locations for plume collection will be calculated prior to the event using the Open Burn Open Detonation Model (OBODM) computer model (Cramer, 1998) and local meteorological conditions. During the week of March 8th, an initial, single, "pre-sampling" M1 burn will be used to verify the model output and to determine effective burn duration and the CO_2 concentration-time profile. This sampling may alternatively use a smaller Kingfisher balloon which has a rated lift of 8 lbs. The larger balloon was tested and found to have a practical lift of 43 lbs versus its rated lift of 34 lbs. When accounting for a 3%/1000 ft altitude penalty, we anticipate a 6.8 lb practical lift for the small Kingfisher which will enable us to easily loft the 2.2 lb LI-COR Biosciences LI-820 CO_2 monitor and its 2 lb pump/filter and battery. This pre-sampling burn will determine the frequency of burn ignitions and the optimal standoff distance. If the elevated CO_2 profile is short in time, then the period between the serial ignitions should be short. If the profile is sustained, then a longer period is sufficient. These profile data also need to be reconciled with required standoff distances and optimal post-ignition positioning. If sufficient concentrations are possible outside of the safety arc, then successive ignitions will not require personnel retreat beyond the safety arc. Successful plume location and pollutant concentrations will be determined by examination of the HOBO data of logged CO_2 concentration and analysis of the CO_2 and benzene (during the actual testing) concentrations in the Summa canisters. These canisters will be sent via overnight courier to an analytical laboratory in California (CasLab, Simi Valley) for analysis. CasLab was selected after talking to three vendors on the basis of their very low naphthalene detection limits, their ability to run low level calibration curves for naphthalene, and their ability to respond quickly. These data will provide feedback on our ability to successfully maneuver into the plume and our mass collection rate of pollutants, complementing our CO_2 data. On-board GPS measurements will be used to determine the position of the Flyer (altitude, coordinates) relative to the OB/OD event and, with CO_2 measurements, be used to determine the efficacy of the OBODM output.

The likely testing scenario will include successive burns, timed to insure high concentrations within the plume, but with enough time to maneuver the Flyer for optimal plume capture. Up to eight burns in series with a charge of 100 lb each of M1 propellant per burn are envisioned for each event, for a total of 1600 lbs per day (morning and afternoon series) maximum (see Table 3-4). The M1 will be burned on a concrete pad

(Figure 3-1) with a metal burn pan. At the time of this writing, re-usable, sheet steel pans were being constructed with a 100 lb capacity, although two co-located pans might be ignited simultaneously to achieve a 200 lb burn, if desired (see Figure 3-2). Each burn will have about 5-10 minutes between burn ignitions, depending on the plume duration. The estimated sampling time is up to 10 minutes per burn. To the extent possible, the burn pans will be aligned collinearly with the burn vector to minimize Flyer repositioning. The number of ignitions will depend on the calculated amount necessary to exceed the analyte detection limit, judged from historical emission factors and the rate and amount of CO_2 collected at the site during the pre-sampling trial burn. Upon detection of sufficiently elevated carbon dioxide levels above background, determined in part by the single pre-test and small balloon CO_2 measurements, a trigger circuit will initiate VOC and semi-volatile sampling.

Sampling time estimates for each target analyte used literature emission factors, ambient air background concentrations, and our preliminary analyses of the contaminant level of the sampling media. The most difficult analytes to detect are likely naphthalene and benzene. Published emission factor values were used in OBODM to predict plume concentrations. Together with our method sampling rates, required analyte mass was determined. These mass values were then compared to the ambient air levels and method detection limits. The estimated sampling times necessary to equal or exceed ambient air levels and/or method detection limits were determined and presented in Table 3-5. This values should only be construed as an order of magnitude approximation due to compounding uncertainty in emission factors and in the OBODM dispersion model.

It is anticipated that personnel will always be outside of the safety range during ignition and burning. Upon completion of the event sampling (one to four burns), the Flyer will be brought down. Data will be downloaded from the on-board data logger. The Summa canister will be removed, sealed, and shipped to the laboratory with its chain of custody sheet (COC, see section 3.9). The semi-volatile sampling media sandwich will be removed, logged, and preserved before shipment to RTP. The filter sample will be logged and its COC will be shipped to an outside laboratory for Pb analysis by EDXRF and total PM by gravimetric analysis.

Figure 3-1. Open Burn Site

Table 3-4. Open Burn Test Plan

Date	M1 burn	VOC, Summa canister	Semi-volatiles, PUF/XAD-2/PUF	Pb and PM	CO_2
3/15/2010		Field blank	Field blank	Field blank	Background (upwind)
		Background (upwind)	Background (upwind)	Background (upwind)	Background (upwind)
	8*100 lb	X	X	X	X
3/16/2010	8*100 lb	X	X	X	X
	8*100 lb	X	X	X	X
3/17/2010	8*100 lb	X	X	X	X
	8*100 lb	X	X	X	X
3/18/2010	8*100 lb	X	X	X	X
	8*100 lb	X	X	X	X
3/19/2010	8*100 lb	X	X	X	X
	8*100 lb	X	X	X	X
3/20-21/2010	spares				

Total of 7200 lbs M1; X = Analyte sampling. Number of analytes sampled during each run will be determined by on-site-determined concentrations and sampling times.

Table 3-5. Required sampling time from multiple burns to surpass anticipated ambient background (PM is considered non-consequential)

Target Compound: sampling method	ΔTime-average concentration in the plume (2 min, μg/m^3)	ΔTime-average concentration in the plume (6 min, μg/m^3)	Ambient air conc. (μg/m^3)	XAD conc. (μg/sample)	Required sampling time (min)$^{-1}$ within the first…	
					2 min of the burn	6 min of the burn
Benzene: Summa canister	0.87	0.29	0.55	NA	2	NA
Naphthalene: Summa canister	0.02	0.005	0.006	NA	2	NA
Naphthalene: PUF/XAD-2/PUF	0.02	0.005	0.006	0.02	4	NA
Lead: filter	TBD	TBD	0	TNA	TBD	TBD

CO_2: NDIR CEM	222 ppm	74 ppm	~ 390 ppm	NA	NA	NA

*1. The sampling time range for sampling with summa canister is dependent on the sampling flow rate, 0.0006-0.003 m^3/min; TBD – to be determined

Figure 3-2. Open Burn Pan (TNT flakes shown)

Due to naphthalene's vapor pressure (1.1 x 10-2 kPa) and boiling point (218 °C) it can show both volatile (VOC) and semi-volatile (SVOC) characteristics. According to EPA Method TO-13 [1] using only filter media prevents efficient collection of certain volatile PAH (naphthalene), and "particulate-phase PAHs will tend to be lost from the particle filter during sampling due to volatilization". In addition, the method also state that naphthalene has only ~35% recovery using PUF as the sorbent media and it is recommended to use XAD-2 resin as the sorbent media when sampling for naphthalene. The method also states that PAH "with vapor pressures above approximately 10-8 kPa will be present in the ambient air substantially distributed between the gas and particulate phases".

The ambient air concentrations at Tooele from NATA 2002 (0.006 ug/m3) is modeled. The naphthalene concentrations were modeled using the emissions-based methodology using emission inventory data [2]. Based on what Method TO-13 states and due to naphthalene's characteristics it should not be present in the atmosphere in particulate form. The data from the emission inventory and monitored data should been sampled according to methods, hence the NATA value should not be multiplied by 4 (i.e. 0.006 ug/m3 already represents both gas and particulate phase).

A better knowledge of the actual naphthalene and benzene background concentrations at Tooele will be available the second week of sampling since background samples will be sampled and shipped for analyses during the first week.

The Tooele naphthalene background concentration is cited as 0.006 µg/m^3 (NATA, 2002). Based on literature values for emission factors (Table 3-2), OBODM was used to estimate the plume concentration at the Flyer under anticipated sampling conditions (100 lb of M1, 35 m from the burn, height of 15-20 m, and a wind speed of 2 m/s). Since the literature-cited emission factor for naphthalene (Table 3-2) was determined by sampling semi-volatiles on a quartz-fiber filter (DTB, 1992), it only reflects the particulate phase and misses the volatile phase. A recent ambient air study (He & Balasubramanian, 2009) showed that 20% of the ambient air concentration of naphthalene is found in the particulate phase. Hence, the OBODM-predicted plume concentration was increased by 4X to about 0.02 µg/m^3 as a more accurate prediction of the time-averaged plume concentration from 0 to 2 min (the minimal OB plume sampling time that we reasonably anticipate we can sample). Our preliminary tests for the PUF/XAD method have shown that the naphthalene sampling media, XAD-2, is contaminated with naphthalene even after cleanup, confounding distinctions with sampled emissions. However we have been able to reduce the media concentration from 15 ng naphthalene/g XAD-2 to 1 ng naphthalene/g XAD-2, meaning that each field sample would have a contaminant concentration of 0.02 µg on the 20 g of XAD-2. To obtain an equal amount of naphthalene from the M1 burn as from the XAD contamination we need to sample for 4 and 3 minutes for 100 and 200 lb charges, respectively, at the OBODM-predicted 2 min time-average concentration, or about three burns. We also believe that more than 2 min of effective sampling can be done on each open burn. The PUF/XAD method will also be complemented by the Summa canister method which may show greater ease of detection.

Use of the emission factor for benzene (Table 3-2) in OBODM shows that the plume concentration easily exceeds the ambient air level of 0.55 ug/m^3 (NATA, 2002). The ratio of sampled emissions and background emissions would be 2/1 for benzene when sampling from 0 to 2 min after ignition. Hence, benzene poses less of a sampling time (volume) challenge than naphthalene.

3.3.2 Open Detonation

The balloon and Flyer will be pre-positioned downwind of the detonation site with the aid of small balloons and smoke grenades. Two ATVs with electric, remotely-controlled winches and tethers will be used to anchor and maneuver the balloon. The ATVs and the ground-fixed balloon/Flyer will likely be located inside the safety stand-off distance, each behind shrapnel/rock-protective bunkers. All personnel will be outside of the stand-off distance and behind a protective bunker. When the balloon is no longer in danger of being damaged from the shrapnel and shock wave of the last detonation, it will be released to fly up into

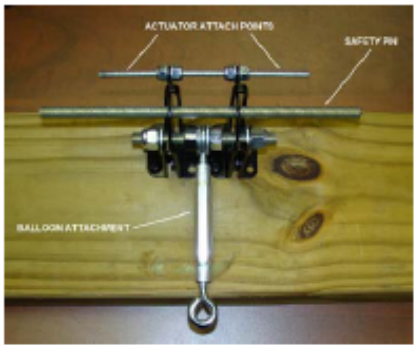

Figure 3.3. Balloon release mechanism.

position. The balloon/Flyer will be released from its ground-based shelter using wireless (2.4GHz) remote control to open the balloon clamp (see Figure 3-3). The clamp will be opened by using two 12VDC powered linear actuators with a two inch throw. Each actuator will provide 18lbs of pull force that will be more than sufficient to actuate the release. The release mechanism will have provisions for a safety pin to prevent inadvertent release during setup and configuration. This release mechanism, its battery, radio receiver, and ballast will be mounted on a pallet. The pallet will have enough ballast to safely endure the detonation shock wave and any gusts of wind that may occur prior to release. Once deployed, the balloon will be maneuvered by retracting and extending the electric winches via remote control. Additional maneuvering can be achieved by manning the ATVs with drivers but this will only be done after the required safety period for personnel has expired and/or permission has been given by the range control officer. To keep the balloon/Flyer's location optimized in the plume, personnel will use visual observation and a high-CO_2 – triggered flashing light mounted on the Flyer.

An initial, single, "pre-sampling" detonation during the week of March 8th will be used to determine effective shrapnel zones (for the equipment), plume duration, and the CO_2 concentration-time profile. This detonation will determine the frequency of detonations and the optimal standoff distance. If the CO_2 profile is short in time, then the period between ignitions should be short. If the profile is sustained, then a longer period is sufficient. Modeling, however, predicts rapid dispersion of the pollutants, requiring detonations in rapid succession. This will ensure high concentrations within the plume, but with enough time to maneuver the Flyer for optimal plume capture. This may mean about 5-15 seconds between detonations. The number of ignitions will depend on the calculated amount necessary to exceed the analyte detection limit, judged from historical emission factors and the rate and amount of CO_2 collected at the site.

On each morning or afternoon of sampling, up to three detonations in series with a charge of 100 lb each of TNT will occur, for a total of 1,200 lbs per day, maximum. Each detonation will have about 5-15 seconds between initiation to maximize the plume concentration while minimizing the safety standoff distance (through minimizing the charge size).

Multiple morning and afternoon detonations may be used to create a single, composite sample. This single sample will be created by reusing the same sorbent media during multiple events. The primary indicator of required composite samples will be the CO_2 mass collected and the published emission factors. Upon completion of sampling, the Flyer will be brought down for downloading the on-board data logger. The Summa canister will be removed, sealed, and shipped to the laboratory with its chain of custody sheet (COC). The Semi-volatile sampling media sandwich will be removed, logged and preserved before shipment to RTP. The pre-weighed sample filter will be logged and its COC will be shipped to a commercial laboratory for determination of PM mass and lead.

Table 3-6 presents a test plan for the open detonation tests.

Table 3-6. Test Plan for Open Detonation Sampling

Date	TNT	VOC, Summa canister	Semi-volatiles, PUF/XAD-2/PUF	PM	CO2
3/222010		Field blank	Field blank	Field blank	Background (upwind)
		Background (upwind)	Background (upwind)	Background (upwind)	Background (upwind)
	4*100 lb	X	X	X	X
3/23/2010	4*100 lb	X	X	X	X
	4*100 lb	X	X	X	X
3/24/2010	4*100 lb	X	X	X	X
	4*100 lb	X	X	X	X
3/25/2010	4*100 lb	X	X	X	X
	4*100 lb	X	X	X	X
3/26/2010	4*100 lb	X	X	X	X
	4*100 lb	X	X	X	X
3/27/2010	spare				

3600 lbs TNT total (5400 lbs TNT total if the site allows 3*200 lbs). Four detonations in series is limited by the current pad size. Period is 5 to 15 s between detonations with 15 s preferable by the Range personnel. Each detonation is 52 ft apart (65 ft, if 200 lbs) and the 200 lb TNT safety distance is 1,919 ft (100 lb is 1,743 ft). Charges will be placed collinearly with the wind vector, to the extent predictable.

As with OB, sampling time estimates for each target analyte used literature emission factors and ambient air background concentrations as well as our preliminary analyses of the contaminant level of the sampling media. Table 3-7 shows that only the PUF/XAD/PUF method for naphthalene may require multiple 100 lb detonations to reach desired concentration levels. At the time of writing this QA Plan, the Depot was inquiring into the possibility of detonating 200 lbs per test. Note that the literature emission factor for naphthalene is ~ 100 times higher for OD than for OB, even though the CO_2 emission factors are nearly the same.

Table 3-7. Required sampling time to surpass anticipated ambient background concentrations and method detection levels during OD. 200 lb of TNT (one charge), 61-100 m from the detonation, and wind speed of 2 m/s. (PM is considered non-consequential).

Target compound: Sampling Method	ΔTime-average concentration in the plume (2 min, μg/m^3)	ΔTime-average concentration in the plume (4 min, μg/m^3)	Ambient air conc. (μg/m^3)	XAD conc. (μg/sample)	Required sampling time (min) within the first…	
					2 min of the detonation	4 min of the detonation

Benzene: Summa canister	2.8-1.4	1.4-0.7	0.55	NA	1	1
Naphthalene: Summa canister	0.2-0.1	0.1-0.05	0.006	NA	1	1
Naphthalene: PUF/XAD-2/PUF	0.2-0.1	0.1-0.05	0.006	0.02	1	1
CO_2: NDIR CEM	21-10 ppm	11-5 ppm	~ 390 ppm	NA	NA	NA

3.4 Sampling methods and other critical measurements

3.4.1 Carbon Dioxide by NDIR CEM

Carbon dioxide measurements will be performed using LI-COR Biosciences LI-820 non-dispersive infrared (NDIR)-based CEMs mounted on the Flyer. This unit is configured with the optional 14 cm optical bench, giving it an analytical range of 0-2,000 ppm with an accuracy specification of <2.5% of reading. Carbon dioxide measurements are expected to vary between ~380-750 ppm. Signal averaging can be adjusted from 0-20 seconds per reading. The LI-COR Biosciences LI-820 CEM is equipped with a programmable alarm output. This output is capable of controlling solenoids as well as visual and audible alarms. Based upon preliminary tests (prior to March 15, 2010) this alarm circuit will be programmed to turn on when above ambient levels of carbon dioxide, i.e., the Flyer is within the plume. This alarm circuit will be used to turn on pumps and open solenoid valves, as described below in section 4.2. The LI-COR LI-820 is equipped with adjustable high and low alarm values and for each of these a "dead band" value can be chosen i.e., the upper alarm is activated at the chosen value and remains activated until the CO_2 concentration drops below the set dead band value.

3.4.2 Summa Canister Sampling for VOCs and Carbon Dioxide

Volatile organics will be sampled via Method TO-15 "Determination of Volatile Organic Compounds (VOCs) in Air collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)." http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-15r.pdf. Sampling for VOCs will be accomplished using laboratory-supplied 6 L Summa canisters. This canister will be equipped with a pressure gauge, manual valve, critical orifice assembly (COA) and a solenoid valve, the latter controlled by the carbon dioxide trigger circuit. Columbia Analytical Services, 2655 Park Center Drive, Suite A Simi Valley, CA, 93065 will provide summa canisters with a 12V valve with orifice and filter already put together. The laboratory will configure and calibrate the critical orifice assemblies and ship them to the field along with the Summa canisters Separate valve/orifice/filter combination for an anticipated range of 1, 2, 6, and 10 minutes

are anticipated. This range of sampling durations is meant to sample the short, several minute peak concentration plumes and longer, multi-minute peak concentration plumes. The shorter sampling periods risk representativeness and the longer sampling periods risk sample dilution and detectability. These sampling rates will likely be different for OB and OD experiments, and for the number of plumes to be collected as a single sample.

The Summa canister will be hung from the bottom of the Flyer and will have its solenoid valve controlled by the LI-COR LI-820's alarm circuit. At the beginning of a sample collection, the gauge will be checked to ensure no leakage has occurred; then the manual valve will be opened. When the LI-COR LI-820 measures elevated levels of carbon dioxide, its alarm circuit will enable a solid state relay, which will open the canister's solenoid valve and sampling will occur at the critical orifice's calibrated flow rate. The solenoid valve will close and sampling will cease when carbon dioxide readings return to ambient levels. Following the end of sampling, the manual valve will be closed, the canister will be dismounted from the Flyer, the COA will be removed, and the canister will be returned to its shipping container.

Each Summa canister sample will also be used for analysis of carbon dioxide by GC, utilizing EPA method 25C. Method 25C also specifies gas sample collection by evacuated cylinder.

3.4.3 Semi-volatile sampling

In a similar manner, semi-volatile sampling will occur using a PUF/XAD-2 resin/PUF sorbent sandwich. This sandwich will be delivered to the site already mounted in a glass tube with clamping flange. The sandwich will be prepared for sampling by removing it from its shipping container, removing the aluminum foil ends, and mounting it on to a MINIjammer brushless direct current (BLDC) blower (AMETEK). Semi-volatile sampling will be performed using a BLDC low voltage blower for a nominal sampling rate of 0.25 m^3/min. The blower will be controlled by the carbon dioxide alarm circuit. Flow rate will be measured by pressure differential across a calibrated venturi. A venturi consists of a carefully calculated and constructed constrictor. As used here, it will be mounted on the outlet of the semi-volatile sampler. A venturi has the property that fluid pressure through a constricted section of pipe is reduced. The fluid velocity must increase through the constriction to satisfy the equation of continuity, while its pressure must decrease due to conservation of energy. As such, a measurement of ΔP between the venturi's inlet and constricted diameter body will measure this pressure drop and that data may be used to calculate flow rate. In practice, a calibration curve is developed from ΔP and actual flow measurements. The voltage equivalent to this pressure differential will be recorded on the HOBO external event logger. The APPCD Metrology lab will perform these measurements using the venturi's matched transducer and a Roots meter. Following sampling, the sandwich will be removed from the Flyer, the ends will be sealed with clean aluminum foil, it will be returned to its shipping container, and stored at 4°C until shipped to the laboratory.

Naphthalene is being sampled by the PUF/XAD method, in addition to the Summa canister method, since the Summa method has uncertain recoveries for less volatile compounds. The PUF/XAD sorbent method will also allow us to look for other semivolatiles, including PAHs.

3.4.4 Particulate matter sampling

Particulate matter sampling will occur using a 47 mm tared Teflon filter. The filters will be shipped to the site pre-tared and mounted in sealed petri dishes. The filters will be placed in a filter holder and will be connected to the sampling pump. PM sampling will be performed via an SKC Leland Legacy Sample pump with a constant airflow of 15 L/min. The internal flow sensor measures flow directly and acts as a secondary standard to constantly maintain the set flow. The volume display is continually updated, based on corrected flow rate multiplied by sampling time. The display presents the pump serial number, pump software revision level, flow rate, volume, temperature, atmospheric pressure, time of day, run time, and pump status, i.e., hold and run as well as setup information. The pump will be controlled by the carbon dioxide alarm circuit. Following sampling, the filter holders will be dissembled and the filters will be placed in 47 mm petri dishes with twist-lock closures. A gel band will also be installed as further insurance against seals opening during preservation and shipment. The sealed petri dishes will be placed in a reclosable bag pre-loaded with desiccant.

It should be noted that detonations occur on soil surfaces and, as such, the plume includes significant soil particulate matter. This is reflected in Table 3-2 where the open detonation PM_{10} emission factor is much larger than the charge weight. One grab sample will be collected from soil at the OD site using a 20 mL scintillation vial. The vial will be sealed with a non-metallic threaded cap and stored for shipment to the laboratory.

3.4.5 Sampling Time

Sample times for the Summa canister and particulate filter are not separately recorded. Sampling time for the Summa canister, semi-volatile sorbent sandwich, and particulate filter are all based upon the same carbon dioxide switched alarm. They are, therefore, identical (up to the point where the summa canister has been filled to ambient pressure, at which point it ceases to collect sample). Sample time is, therefore, based upon the semi-volatile sampling pump where voltages from the venturi's differential pressure measurement will be recorded on the HOBO external event data logger.

3.5 List of Samples

- Summa Canisters, 6 L, with calibrated critical orifice assembly hardware
- PUF/XAD-2 resin/PUF will be prepared from cleaned PUF plus manufacturer-cleaned XAD-2 resin. They will be packed in the glass samplers and sealed with clean aluminum foil. Cleaned PUF consists

of as-received PUF that is solvent cleaned using sequential toluene and dichloromethane elution. It is dried under a flowing nitrogen stream prior to use.

- Filter, Teflon, 47 mm, tared.
- Grab samples from the OD soil particulate are collected in a 20 mL scintillation vial with non-metallic caps. Cap to be sealed with vinyl or electrical tape after sample collection. An OSHA-21 seal is wrapped lengthwise after sample collection.

3.6 Sample Preservation Requirements

- Filter samples are preserved by storage under desiccant.
- Soil grab samples are stored in a sealed glass vial.
- Samples collected on PUF/XAD-2/PUF will have the ends sealed with new aluminum foil and will be refrigerated after collection. Samples must be shipped and extracted within 14 days of sampling.
- Summa canister samples for VOC analysis must be analyzed within 14 days of collection.

3.7 Numbering Method

Each sample data sheet and sample fraction will be given an identifying code number that will designate the run number. The codes and code sequence will be explained to the field team and laboratory personnel to prevent sample mislabeling. Proper application of the code will simplify sample tracking throughout the collection, handling, analysis, and reporting processes. The sample coding to be used in this study is described in Table 3-8.

For each sample a chain of custody sheet will be generated. For a sample collected in a Summa canister, this sheet will also record the canister's associated serial number and bar code. For a particulate sample, the COC will also record the filter numbering from the laboratory performing the conditioning and taring.

Table 3-8. Sample Coding

AA-CC-DD-EE-MMDDYY-HHMM		
	Sample Code	**Code definition**
AA	OB	Type of test (OB = Open detonation, OD = Open detonation
CC	FB	Test condition (FB = Field blank, PM = Plume Sample, US = Upwind Sample
DD	FT	Sampling Media (FT = Filter, SP =Sorbent Pack, SC

		= Summa canister)
EE	01	Sample Number (01, 02, 03, etc.)
MMDDYY	031510	Date Field, month/day/year
HHMM	1523	HH = Hour, numeric 24 hour convention MM = Minute, numeric 24 hour convention

3.8 Packing and Shipping

- Summa canisters are shipped to and from the field in boxes as per CasLab instructions. The critical orifice assemblies are individually wrapped in bubble wrap and shipped with the associated canister. Summa canisters are shipped overnight for morning delivery to the contract laboratory.

- Samples collected on PUF/XAD-2/PUF are shipped overnight in insulated chests with chilled refrigerator packs.

- Sampled filters are returned to the SKC cassettes and sealed with the Omega gel bands. The cassettes are marked with the sampling information. The cassettes are stored in Zip-Lock bags with desiccant. Filter samples are shipped to the laboratory separate from bulk samples.

- Grab samples in scintillation vials are shipped to the laboratory separate from air samples.

- FedEx procedures for Summa Canisters are listed below:
  - Materials, including sampling media from CasLab & Chester Lab Net, will be shipped to:

    Tooele Army Depot
    Building 519
    Attn: Roger Hale
    Tooele, UT, 84074

  - Sampled Summa Canisters will be shipped from Tooele Army Depot to:

    CasLab
    2655 Park Center Drive, Ste. A
    Simi Valley, CA 93065
    Tel: 805 526 7161

  - 47-mm filters samples will be shipped from Tooele Army Depot to

    Paul Duda
    Chester LabNet

12242 SW Garden Place
Tigard, OR 97223
(503)624-2183 ext. 100
fax (503)624-2653

3.9 Chain of Custody Form

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CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

RN990270.0052 (if Arcadis)	Determination of Emission factors from OB/OD of Military Ordnance													
SAMPLERS:						Requested Analyses								
SAMPLE ID	DATE	TIME	MATRIX	Composite/ Grab	# Containers	1	2	3	4	5	6	7	8	Remarks

Requested Analyses	Special Instructions/Comments:					
1						
2						
3						
4	Laboratory Information and Receipt					
5	Lab Name:			☐ Cooler packed with ice		
6	Shipping Tracking #					
7	Specify Turnaround Requirements:			☐Cooler custody seal intact		
8						
9	Relinquished by:	DATE	TIME	Received by:	Relinquished by:	Received by:
10						
11						
12	Relinquished by:	DATE	TIME	Received by:	Relinquished by:	Received by:
13						
14						

4. MEASUREMENT AND ANALYTICAL PROTOCOLS

Critical measurements are: CO_2, Pb, Total PM, benzene, naphthalene, sample flow rates, and times. This will include background (ambient) and in-plume events.

4.1 Methods

The following sections describe the analytical methods that are planned for the determination of benzene, naphthalene, carbon dioxide, total particulate, and particulate bound lead. Sampled volumes will be calculated as the multiplicand of sample flow-rate and sampling time. These are also described below.

4.1.1 VOCs

Benzene and naphthalene will be analyzed using EPA Method TO-15 (EPA, 1999), by Columbia Analytical Services using selective ion monitoring (SIM) mode GC/MS. The analysis of canister samples is accomplished with a GC/MS system. Fused silica capillary columns are used to achieve high temporal resolution of target compounds. Linear quadrupole or ion trap mass spectrometers are employed for compound detection. The heart of the system is composed of the sample inlet concentrating device that is needed to increase sample loading into a detectable range. As performed here, a 1 L aliquot is pulled from the Summa canister and analyzed.

The recommended GC/MS analytical sequence for samples during each 24-hour time period is as follows:

- Perform instrument performance check using bromofluorobenzene (BFB).
- Initiate multi-point calibration or daily calibration checks.
- Perform a laboratory method blank.
- Complete this sequence for analysis of about 20-25 field samples.

An internal spiking mixture containing bromochloromethane, chlorobenzene-d5, and 1,4-difluorobenzene at 10 ppmv each in humidified zero air is added to the sample or calibration standard. 500 µL of this mixture spiked into 500 mL of sample will result in a concentration of 10 ppbv. The internal standard is introduced into the trap during the collection time for all calibration, blank, and sample analyses. The volume of internal standard spiking mixture added for each analysis must be the same from run to run.

A blank canister will be analyzed daily. The area response for each internal standard (IS) in the blank must be within ±40 percent of the mean area response of the IS in the most recent valid calibration. The retention time for each of the internal standards must be within ±0.33 minutes between the blank and the most recent valid calibration.

4.1.2 Semi-volatiles

Semi-volatiles and naphthalene in particular will be sampled using EPA Method TO-13 A (EPA, 1999). Semi-volatile sorbent sandwich samples will be prepared for analysis by solvent extraction utilizing dichloromethane and then concentrated by solvent evaporation. An internal standard, d8-naphthalene, will be added. Samples will be analyzed utilizing full-scan mode at first, then SIM mode for additional sensitivity, if necessary. Laboratory and field blanks will be collected and prepared.

4.1.3 Carbon Dioxide by CEM

Carbon dioxide measurements will be performed using a Biosciences LI-820 NDIR-based CEM mounted on the Flyer. This unit is configured with the optional 14 cm optical bench, giving it an analytical range of 0-2,000 ppm with an accuracy specification of <2.5% of reading. The instrument will be preceded by a filter for particulate matter removal prior to the optical lens.

4.1.4 Integrated Carbon Dioxide Measurement

Carbon dioxide will be measured by Method 25C, in which an aliquot of the collected Summa canister sample is injected into a sample loop equipped GC/FID. While method 25C is designed for nonmethane organic compounds (NMOCs), section 11.1.3 specifically cites the elution of sample CO_2. The method specifically converts all analytes first to CO_2 and then to CH_4 to provide uniform response across all analytes including carbon dioxide.

4.1.5 Total PM by Gravimetric Analysis

Total PM will be measured gravimetrically as the difference between final and tare masses for each filter. The weighing of the filters will follow the procedures described in 40 CFR Part 50, Appendix J, 1987. The analytical balance used to weigh filters must be suitable for weighing the type and size of filters and have a readability of ±1 µg. All sample filters used shall be conditioned to 20-23 °C and 30-40 % RH for a minimum of 24 h immediately before both the pre- and post-sampling weighing. Both the pre- and post-sampling weighing should be carried out on the same analytical balance, using an effective technique to neutralize static charges on the filter. The pre-sampling (tare) weighing shall be within 30 days of the sampling period. The post-sampling conditioning and weighing shall be completed within 240 hours (10 days) after the end of the sample period.

4.1.6 Lead

The particulate matter collected on Teflon filters is also appropriate for the determination of lead. EPA Compendium Method I0-3.3 (1999) specifies the analysis by energy dispersive x-ray fluorescence spectrometry (EDXRF). This method is compatible with particulate on filters, is quite sensitive for lead, and is non-destructive. This means that the particulate matter and substrate survive the analysis intact; and may be archived or analyzed by other methods.

4.2 Calibration

4.2.1 VOCs

Prior to the analysis of samples and blanks, but after the instrument performance check standard criteria have been met, each GC/MS system must be calibrated at five concentrations that span the monitoring range of interest in an initial calibration sequence to determine instrument sensitivity and the linearity of GC/MS response for the target compounds. For example, the range of interest may be 2 to 20 ppbv, in which case the five concentrations would be 1, 2, 5, 10 and 25 ppbv.

4.2.2 Semi-volatiles

The GC/MS will be calibrated using a 5-point calibration with d8-naphthalene internal standard.

4.2.3 Carbon Dioxide by CEM

The LI-COR Biosciences LI-820 NDIR-based CEM is calibrated using a zero (nitrogen) and span gas (CO_2 in nitrogen). This will be performed in the laboratory prior to transportation to the field. Linearity checks will be performed in the lab following the calibration using two additional cal gases of intermediate CO_2 concentrations.

In the field, zero and span checks will be performed on a daily basis.

4.2.4 Integrated Carbon Dioxide

The GC is calibrated utilizing carbon dioxide in nitrogen certified calibration gases. A 4 point calibration will be performed.

4.2.5 Total PM by Gravimetric Analysis

Calibration for determining mass of conditioned media is performed as per "Quality Assurance Guidance Document 2.12".

4.2.6 Lead

In general, calibration determines each element's sensitivity, *i.e.*, its response in x-ray counts/sec to each $\mu g/cm^2$ of a standard and an interference coefficient for each element that causes interference with another one (See section 3.2 above). The sensitivity can be determined by a linear plot of count rate versus concentration ($\mu g/cm^2$) in which the slope is the instrument's sensitivity for that element. A more precise way, which requires fewer standards, is to fit sensitivity versus atomic number. Calibration is a complex task in the operation of an XRF system. Two major functions accomplished by calibration are the production of reference spectra which are used for fitting and the determination of the elemental sensitivities. Included in the reference spectra (referred to as "shapes") are background-subtracted peak shapes of the elements to be analyzed (as well as interfering elements) and spectral backgrounds. Pure element thin film standards

are used for the element peak shapes and clean filter blanks from the same lot as routine filter samples are used for the background. The analysis of Pb in PM filter deposits is based on the assumption that the thickness of the deposit is small with respect to the characteristic Pb X-ray transmission thickness. Therefore, the concentration of Pb in a sample is determined by first calibrating the spectrometer with thin film standards to determine the sensitivity factor for Pb and then analyzing the unknown samples under identical excitation conditions as used to determine the calibration. Calibration shall be performed annually or when significant repairs or changes occur (e.g., a change in fluorescence X-ray tubes, or detector). Calibration establishes the elemental sensitivity factors and the magnitude of interference or overlap coefficients.

Thin film standards are used for calibration because they most closely resemble the layer of particles on a filter. Thin films standards are typically deposited on Nuclepore substrates. Thin film standards are available from NIST and commercial sources.

A background spectrum generated by the filter itself must be subtracted from the X-ray spectrum prior to extracting peak areas. Background spectra must be obtained for each filter lot used for sample collection. The background shape standards which are used for background fitting are created at the time of calibration. If a new lot of filters is used, new background spectra must be obtained. A minimum of 20 clean blank filters from each filter lot are kept in a sealed container and are used exclusively for background measurement and correction. The spectra acquired on individual blank filters are added together to produce a single spectrum for each of the secondary targets or fluorescers used in the analysis of lead. Individual blank filter spectra which show atypical contamination are excluded from the summed spectra. The summed spectra are fitted to the appropriate background during spectral processing. Background correction is automatically included during spectral processing of each sample.

4.2.7 Sampling Flowrate

- Summa canister sampling rate is based upon a calibrated critical orifice assembly (COA) supplied by the commercial analytical laboratory supplying the canisters. The COA will be configured as per the WAM's instructions and calibrated by the supplying laboratory.

- Semi-volatile sampling utilizes the BLDC blower. The flowrate is measured by the pressure differential measured across the installed venturi. The voltage equivalent to this pressure differential will be recorded on the HOBO™ external event logger. This will be calibrated in the APPCD Metrology laboratory prior to being deployed utilizing a Roots meter.

- The filter sampler utilizes an SKC Leland Legacy constant rate sample pump. The patented (U.S. Patent No. 5,892,160) internal flow sensor measures flow directly and acts as a secondary standard to constantly maintain the set flow. Set flow is achieved immediately at start-up and flow calibration is automatically maintained by built-in sensors that compensate for differences in temperature and atmospheric pressure during sampling. Flow rate: ± 5% of set-point after calibration to desired flow. The

Leland Legacy is programmable with the Leland DataTrac Software using a PC and will presents the pump serial number, pump software revision level, flow rate, volume, temperature, atmospheric pressure, time of day, run time, and pump status, i.e., hold and run as well as setup information. The volume display is continually updated, based on corrected flow rate multiplied by sampling time. The pump will be calibrated with the Gilibrator Air Flow Calibration System (Scientific Instruments), which is a primary standard airflow calibrator.

4.2.8 Sampling Time

Sampling time will be based upon data logged onto the HOBO U12-006 4-channel external logger. Each recorded event is time and date stamped. The HOBO maintains an internal time, which has a time accuracy of ± 1 min per month. Since all sample times are based upon differentials across sampling times on the order of several minutes, no further calibration is necessary.

4.2.9 GPS

The GPS measurements on board the Flyer are not critical measurements but will be used in retrospect, along with the CO_2 time data, to assess the predictive capability of OBODM. The altimeter and the electronic compass in the GPS need to be calibrated before use and after every time the batteries are changed. In order to calibrate the altimeter the current elevation or barometric pressure must be known, which has to be received from a reliable source at Tooele. To receive an accurate calibration of the electronic compass the GPS needs to be leveled and not nearby magnetic fields such as cars and buildings.

5. QUALITY ASSURANCE/QUALITY CONTROL

5.1 Comparisons

As a QA check, the results obtained from integrated extractive sampling and analysis by conventional methods will be compared to the corresponding continuous sampling techniques, when available.

5.2 Quality Objectives and Criteria

The objective of this project is to characterize the emissions for OB/OD events. The data quality objectives (DQOs) define the critical measurements (CM) needed to address the objectives of the test program, and specify tolerable levels of potential errors associated with data collection as well as the limitations of the use of the data. However, the critical measurements used in the computation of the emission data shall also satisfy the data quality indicator goals specified by the respective sampling methods based on a Pass/Fail criterion, such as pre-sampling surrogates recoveries that are not included in the computation.

The following measurements are deemed to be critical to accomplish the project objectives:

- PM weights
- Target pollutant concentrations
- Sample volumes
- Sampling time

These measurements are needed to determine the emission factors and emission rates for the various pollutants. The time sequence of sampling events must be recorded on the same time axis as are the current CEM data streams. This is essential to determine the extent of the emissions as a function of the damper mode (closed or open) and the fuel charge consumption as a function of time.

5.3 Data Quality Indicator Goals for Critical Measurements

The data quality indicators (DQIs) are specific criteria used to quantify how well the collected data meet the DQOs. The DQI goals for the critical measurements correspond to and are consistent with the standards set forth in each respective referenced EPA Method. Accuracy and precision estimates are available where noted, and completeness goals for data collection and sampling are indicated in Table 5-1.

Table 5-1. Data Quality Indicators

Measurement Parameter	Analysis Method	Recovery	Detection Limit	Completeness %
Benzene	EPA Method TO-13 A	NA	0.15 µg/m^3	90
Naphthalene	EPA Method TO-15	70-130%	0.1 µg/m^3	90
Naphthalene	EPA Method TO-13 A	25-130%	30 ng/m^3	90
Carbon dioxide	GC	95%	NA	90
Measurement Parameter	**Analysis Method**	**Accuracy**	**Detection Limit**	**Completeness %**
PM	Analytical Balance	15 %	1 µg	90
Lead	EDXRF	6%	0.45 µ/m^3	90
Carbon dioxide	NDIR CEM	3 % of reading	NA	90
Flowrates	Venturi differential pressure	99+%	NA	100
	Internal flow sensor	± 5 % set point	NA	100

5.3.1 DQI Goals for the Target Pollutants

The DQI goals for the critical measurements for PM and organic sampling (listed in Table 5-1) correspond respectively to the standards set forth in each respective EPA Method.

5.3.1.1 PAHs

A single TBD deuterated PAH (see Table 5-2) will be added to the XAD-2 trap before the sample is collected. The surrogate recoveries are measured relative to the internal standards and are a measure of the sampling train collection efficiency. All surrogate standard recoveries shall be between 25 and 130 percent. A deuterated recovery standard, TBD, will be added before mass analysis.

Table 5-2. PAH Surrogates, Composition & Purpose

Spiking Solution	Analytes	Special Notes
Pre-sampling surrogate	TBD, deuterated PAH; Naphthalene std	added to sorbent pack prior to shipment to field
PAHs - Internal Standards	Naphthalene-D8	Added to the sample prior to extraction
Recovery	TBD, deuterated PAH	Added before mass analysis

5.3.2 Representativeness and Comparability

At least five samples per analyte are targeted for measurement and comparison. Results will be compared with minimally existent emission factors from the literature.

5.4 Assessing DQI Goals

In general, data quality indicator goals are based on either (1) published specifications, (2) related quantities (like drift for precision), or (3) engineering judgment based on previous experience with similar systems.

5.4.1 Precision

In order to measure precision, it is necessary to make replicate measurements of a relatively unchanging parameter. The ability to measure precision is dependent upon the type of data that is being measured. With an analytical balance or a CO analyzer, all it takes to measure precision is to measure the value of a reference standard more than once and compare the two numbers. To check precision, any pair of duplicate measurements can be entered into an equation of the form:

$$RPD = \frac{100 \, x \, |Q - B|}{(Q + B) / 2} \tag{5-1}$$

Where:

Q = results from one run

B = results from second duplicate run

RPD = relative percent difference

If more than one pair of duplicate measurements is available, an entire population of individual precision can be generated. The best way to represent all of the replicate responses to a reference standard is with a relative standard deviation (RSD):

$$RSD = \frac{\sqrt{\sum_{i=1}^{n} (Y_i - \overline{Y})^2}}{\sqrt{n-1}\,\overline{Y}} \tag{5-2}$$

This is often expressed as a percent.

When there are no reference standards, however, precision calculations are at the mercy of system stability. Furthermore, several of the measurements only generate one value per run (i.e., for 2 runs per condition, Precision = RPD). Therefore, for measurements that are compared to a reference standard, precision can be measured on a per-run basis as RPD. Overall precision for the entire test series can be expressed as RSD. For measurements that have no reference standard, precision is expressed as RSD for multiple measurements per run, and as RPD for singular measurements.

5.4.2 Accuracy

The accuracy of a measurement is expressed in terms of percent bias, or, in some cases recommended by the EPA standard methods, in terms of absolute difference. Percent bias is defined as:

$$Percent\ Bias = \frac{R - C}{C} x\ 100 \qquad (5\text{-}3)$$

Where: R = instrument response or reading

C = calibration standard or audit sample value

Accuracy can take on the units of the measurement, it can be expressed as a percentage of the average measurement, or it can be expressed as a percentage of the measurement range.

5.4.3 Completeness

The ratio of the number of valid data points taken that meet DQIs goals to the total number of data points planned is defined as data completeness. All measured data are recorded electronically or on data sheets or project notebooks.

6. DATA ANALYSIS

Data produced includes notes recorded in a laboratory notebook, digital photos of the filters and PUFs, data from the EPA laboratory analyses, and all the sample analysis produced by the accredited laboratory. One laboratory notebook at a time will be maintained for this project, to be used for recording data by any personnel. This laboratory notebook will be archived by the EPA WAM.

6.1 Data Reporting

For each run, digital acquisition data, pictures of the sampling location, raw laboratory results, and processed data will be reported. All data validation criteria will be reported along with deviations from the test setting requirements and associated comments related to these deviations.

6.2 Data Validation

Data validation is performed at the end of the project through an assessment of the Data Quality Indicators (DQIs) that are specific criteria used to quantify how well the collected data meet the Data Quality Objectives (DQOs). The measured DQI for the critical measurements will be compared to the defined DQOs set in this QAPP and that are consistent with the standards set forth in each respective referenced EPA Method.

6.3 Data Storage

Field data will be transferred from the HOBO data loggers to "data sticks" via a laptop computer with a USB port. Electronic data and pictures will be posted in the folder L:\Lab\NRML_Public\GullettResearchUpdates\WA 0-51 on the EPA network share drive upon return from the field or as it is generated or received.

7. Assessment and Oversight

7.1 Assessments and Response Actions

Assessments are an integral part of a quality system. This project is assigned a QA Category IV and does not require planned technical systems and performance evaluation audits. However, should deficiencies be identified by any of the key individuals responsible, an interoffice memorandum will be prepared and submitted to the ARCADIS and EPA project participants. The memorandum will discuss the problem and corrective actions taken. A QA performance evaluation will be performed to determine if DQIs goals were met for the overall project. Any internal audits performed by the ARCADIS QA staff will be followed by a written formal report to the ARCADIS WA Leader.

7.2 Reports to Management

All assessments performed by the EPA QA Representative or internally by the ARCADIS QA Officer will be formally reported to the EPA and ARCADIS WA Managers within 30 days. Findings from the audits will be reported immediately in order for any necessary corrective actions to be implemented.

The final report prepared for this project will contain a discussion of QA procedures and an evaluation of whether or not established DQI goals were met. In the event DQIs are outside of the acceptance criteria, the consequences of the failure to meet specific DQI goals will be discussed.

7.3 Corrective Actions

The ARCADIS WAL (Dr. A. Touati) is ultimately responsible for implementing corrective actions identified through QA Audits. An integral part of any QA program is well-defined procedures for correcting data quality problems. The overall goals of the QA program address the following aspects of data quality:

- Problem prevention
- Problem definition
- Problem correction

For this type of testing, data-quality problems usually require immediate, on-the-spot corrective action. The procedures outlined in this plan are intended to provide for rapid detection of data-quality problems. The experienced personnel assigned to this project will be intimately involved with the data on a daily basis. A data-quality problem will become apparent soon after it occurs. On-the-spot corrective actions will be taken when practical and are expected to be an everyday part of the QA process. The EPA WA Manager will be

notified promptly of QA problems that may require extended time for corrective action. The nature of the problem and corrective steps taken will be noted in the project notebook for future reference.

The ARCADIS QA Officer and the ARCADIS WAL will conduct regular inspections of project notebooks to assure completeness. Any discrepancies requiring prompt data quality problem correction will be resolved by the WAL. Through regular discussions with the project staff, the QA Officer and WAL will ascertain the continuing suitability of analytical systems performance. Because communications between project participants are open and frequent, this system is expected to be effective and will require a minimum amount of paperwork. The ARCADIS QA Officer will make documentation of problems requiring long-term solution.

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Appendix B: Addendum #1 to – QAPP for WP-2153 Work

Addendum to:

Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance

2011 Open Burning Tests

Quality Assurance Project Plan

Category IV / Proof of Concept

March 12, 2011

Brian Gullett Date
U.S. Environmental Protection Agency
Principal Investigator, Grantee Mentor, and Work Assignment Manager

Dennis Tabor Date
U.S. Environmental Protection Agency
Analytical Leader

Johanna Aurell Date
NRC Grantee, Post-Doctoral Fellow to the U.S. EPA
Technical Project Leader

Dahman Touati Date
ARCADIS
Work Assignment Leader

Paul Groff or Robert Wright Date
U.S. Environmental Protection Agency
Quality Assurance Representative

Laura Nessley Date
ARCADIS
Quality Assurance Officer

Introduction

This is an addendum to the QAPP entitled "Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance" allowing for additional work scheduled for Spring, 2011. The Department of Defense's Strategic Environmental Research and Development Program (SERDP) has awarded second year funding to further pursue development of methods for emission characterization of open burning of military propellants. This additional work will focus on multiple propellant types whose composition varies from that of the first year propellant, M1. Tests this year will develop and test additional methods of sampling to characterize these propellants and are based on input from the U.S. Army's Defense Ammunition Center (DAC) and their advisors. New target analytes this year will include perchlorate, chloride, and hydrogen chloride from Cl-containing propellants and additional metals (e.g., Ba) from other propellants. In addition, repeat samples and analyses will be conducted to further develop these sampling methods. All tests will be conducted at the Tooele (Utah) Army Depot test range, the site of the 2010 tests.

This addendum is meant as an addition to the cited QAPP. Differences in test materials, target analytes, sampling and analytical methods, and burn procedures are included.

Schedule

February 18, 2011	Draft QAPP Addendum submitted to EPA and to U.S. Army DAC
March 4, 2011	QAPP Reviewed
March 20, 2011	Team arrives in Tooele
March 21 – April 8, 2011	Field Testing
August, 2011	Draft report
September, 2011	Final report

Propellants

Five Propellants will be tested by Open Burning (OB). These propellants and their composition are listed in Table A1. This table is an amendment to Table 3-1, "Composition of OB and OD Ordnance," in the original QAPP. These propellants were selected by the U.S. Army DAC with criterion of stockpile relevance, method gaps, and emission factor data gaps. Two propellants (of three currently listed) will be selected for their composition of ammonium perchlorate (over 65% by mass). Their OB plumes will be sampled for perchlorate, HCl, and chloride salts. Three propellants were also selected that represent single, double, and triple base compositions. Two of these, M31A1E1 and SPCF, contain metals (barium and lead, respectively) which will enable testing of PM-based metal capture and detection. Note: selection of the ammonium perchlorate propellants is not finalized; these three are examples of potential candidates. At least two perchlorate-based propellants are targeted for testing.

Charge sizes in 2011 will be increased to 200 lbs and will continue to be ignited in metal burn pans. If meteorological conditions permit (e.g., wind speed and cloud cover), up to 300 lbs can be tested in a single charge. The advantage of the larger charge size is the proportionately higher concentration of target analytes in the plume and the greater ease with which limits of detection can be exceeded.

Table A1. Target Propellants.

Propellant Name	Propellant Descriptor	Mass %	Component, CAS #, Chemical formula****	
M31A1E1	Triple Base	To be provided by DAC	Nitrocellulose Nitroglycerin Nitroguanidine	9004-70-0 55-63-0 556-88-7
M26	Double Base	To be provided by DAC	Nitrocellulose Nitroglycerin Barium nitrate Potassium nitrate	9004-70-0 55-63-0 10022-31-8 7757-79-1
SPCF	Single Base	To be provided by DAC	Nitrocellulose Lead carbonate	9004-70-0 598-63-0
ANP-3196-1*	Hawk Sustainer	60-75 15-20	Ammonium Perchlorate (AP) Nitroguanidine	7790-98-9 556-88-7
ANP-3146-1**	Hawk Booster	60-70 15-20	Ammonium Perchlorate (AP) Aluminum powder	7790-98-9 7429-90-5
AnB-3745; ANB-3748 (igniter)***	Atlas V Propellant and igniter	67-70 18-20 0-1 0-1	Ammonium Perchorate (AP) Aluminum Powder Triphenyl Bismuth (TPB) Iron Oxide (in igniter)	7790-98-9 7429-90-5 603-33-8 1309-37-1

* Information obtained from AEROJET MSDS NO. 501, Revision 5.
** Information obtained from AEROJET MSDS NO. 500, Revision 3
*** Information obtained from AEROJET MSDS NO. 13003, Revision 3
****Composition of propellants limited to propellants, explosives, and pyrotechnic (PEP) materials and Metals

Changes to the Flyer

A number of advances were made to the sampling instrumentation package, or the "Flyer." Two Flyers now exist, "Orville" and "Wilbur." Both consist of a lightweight, aluminum frame structure which replaced the solid aluminum structure of the original Flyer. Orville was outfitted with a telemetry system to transmit data to a handheld station. Orville's telemetry system enables the ground crew to monitor CO_2 concentration, battery life, and pressure drop across a filter. These data allow maximization of flight time and optimization of collection by avoiding premature battery changeouts or battery depletion and allowing for filter changes when plugged. Orville was used in July 2010 when monitoring the in situ oil burns at the BP Gulf oil spill.

Wilbur lofts a computer and control software in lieu of the telemetry system. This computer enables data storage like the original Flyer but also allows the sampling to be controlled from the ground and allows the incorporation of multiple triggers. These multiple triggers, for example, allow one to loft multiple summa canisters and trigger, or open, them at different CO_2 concentrations.

A number of other changes are included in both systems. The Ni-Cd batteries were replaced with Li-ion. The 6 L summa canister was replaced with a lighter 1L canister. The semivolatile blower was replaced with a unit that has about four times the flowrate of the old system, up to about 650 L/min. An electrochemical cell for real time CO was added. Continuous PM samplers and black carbon samplers are also optional.

New Target Analytes

Section 3.2 "Analytes and Process Measurements" of the QAPP is amended to include additional analytes and their measurements as well as changes (shown in italics) in Table A2. Emissions to be measured in 2011 will include CO_2, CO, PM_{10} and $PM_{2.5}$, metals (e.g., Pb, Al, and Ba), VOCs, SVOCs, HCl, ClO_4^-, and other chlorinated compounds.

Table A2. Target compounds and sampling and analysis methods (new methods or changed methods in italics).

Target Compound	Sampling Method	Sampling Rate	Analysis
VOCs	TO-15 Summa	*30 s* (from 2-3 L/min)	GC/LRMS
SVOCs	TO-13, PUF/XAD-2/PUF	*650 L/min* (from 200 L/min)	GC/LRMS
$PM_{2.5}$ and PM_{10}	*Filter*	*10 L/min*	*Analytical Balance*
HCl	*Alkali-impregnated filters, silica gel tubes*	*2-4 L/min*	*Ion chromatography*
Carbon monoxide	*EPA Method 25C chemical cell*	*150 mL/min*	*GC*

Measurement Methods for New Target Analytes

Perchlorate will be sampled using a modification of the method discussed in Lamm et al. (1999). The method consists of sampling at a flowrate of 2 L/min through a 37 mm mixed cellulose ester (MCE) filter (0.8 µm pore size) enclosed in a closed-face cassette (SKC Corporation). Perchlorate salts are captured as a solid on the filter, which assumes no perchloric acid formation. Cassette samples will be dissolved/extracted in water, an internal standard added, and then analyzed for perchlorate with LCMS and chloride with ion chromatography as per U.S. EPA SW-846 Method 6850. Samples will be analyzed at Columbia Analytical Services (CAS, NY).

The detection limit for perchlorate is cited as 0.004 µg/filter by CAS (NY). For the purposes of determining required sampling volumes and times to reach perchlorate detection levels, we first assume 100% preservation of the original perchlorate composition as a best case boundary condition and dilution at the Flyer sampler at the ratio observed for C to CO_2 during the 2010 tests. Calculations were done using M7 propellant, containing 8 weight percent potassium perchlorate, as this was indicated early on as a candidate for the testing. The average 2010 sampled concentration of CO_2 from M1 was 460 ppm (against a background of ~ 390 ppm) from a carbon fraction of 30 wt percent in the propellant. From these ratios, the maximum possible concentration of perchlorate we can expect in the M7 plume would be 80 ppm (124 mg/m3). At a sampling rate of 2 L/min, we could expect to collect 0.25 mg/min. When compared against a reported detection limit of 0.004 µg/filter, the required sampling time to reach detection is significantly less than 1 sec. As of February 2011, the expected perchlorate propellants contain >60% ammonium perchlorate, considerably more than the M7 we used for these calculations. Even if only ca. 5% of the original perchlorate is released intact and is diluted to levels below 80 ppm in the plume, sampling for detectable perchlorate should be relatively fast.

The perchlorate may also degrade into chlorine which could react with alkaline earth metals, either within the propellant or entrained from the surrounding soil, to form a metal chloride. Lindsay et al. (1999) noted that HCl could readily be absorbed by entrained soil as well as aluminum oxide from the propellant. These metal chlorides will be captured on the initial perchlorate filter and analyzed by ion chromatography from the same filter.

We also will sample for formation of HCl. Methods for sampling HCl are primarily derived from those intended for sampling inhalable HCl to relate to exposure risk. Silica gel collection methods such as NIOSH Method 7903 (NIOSH 1994) may undersample HCl mist, as particle size collection characteristics on the silica gel sorbent tube do not match the inhalable convention (Howe et al., 2006). While there are considerable questions relating to the relevance of these methods to the inhalable particle/droplet size (Howe et al., 2006), our effort is more concerned with complete capture and quantification. HCl will be sampled in parallel using alkali-impregnated filters following the perchlorate filter and silica gel tubes as per Lindsay et al. (1999). HCl gas is expected to pass through the perchlorate/chloride filter and be adsorbed by a second, quartz filter coated with Na_2CO_3. These coated filters are available in a cartridge from SKC Corporation. Any hydrochloric acid transiently collected on the initial filter is expected to rapidly evaporate and be collected along with the gaseous HCl (Howe, et al. 2006). This method, including a prefilter followed by a Na_2CO_3-impregnated quartz filter, is consistent with a method from France (INRS, 2002), as cited in Howe et al. (2006).

Numerous tests on the prefilter/ Na_2CO_3-impregnated quartz filter method were covered by Howe et al., (2006). They examined pre-filter HCl vapor capture and breakthrough potential. The former did not exceed 0.4% and the latter were all non-detect after collection of 47 to 62 µg of chloride on the alkaline filters. The pre-filter did have a propensity to collect significant HCl when doped with Fe, Fe_2O_3, or ZnO suggesting an underestimation of HCl from the Na_2CO_3-impregnated quartz filter alone when in the presence of propellants metals (e.g., Al from Atlas Igniter propellant) or plume-entrained soil. The extent to which this may relate to our work is uncertain; the experiments of Howe et al. did not control for the amount of dopant on the filter.

This filter will be analyzed for HCl by ion chromatography methods specified in EPA Method 26. The limit of detection for this method is 4 µg/filter (CAS, NY). Assuming that all of the M7 propellant's perchlorate becomes HCl, and assuming a dilution ratio consistent with the 2010 dilution of CO2, we anticipate a maximum possible HCl concentration of 30 ppm or 45 mg/m3. Lindsay et al. (1999) noted that their silica gel tube method did not detection gaseous HCl at levels above 6.5 mg/m^3 (the background contamination level of the silica gel tubes). At a sampling flowrate of 2 L/min, we will need 2.4 s to reach the 4 µg/filter level, assuming a concentration of 30 ppm HCl in the plume. If our plume HCl concentration is actually seven times lower than 30 ppm, equivalent to the 6.5 mg/m^3 background level noted by Lindsay et al., this will be compensated by the higher Cl concentration in our targeted propellants as compared to M7. Nonetheless, we anticipate sampling for approximately 300 s (one day) to obtain a composite sample for HCl analysis.

The perchlorate prefilter and Na_2CO_3 filter both will be analyzed for target analytes prior to sampling at Tooele in order to establish contamination levels. Ambient air background levels will be determined for perchlorate, chloride, and HCl. Moller and Acker (2007) found HCl concentration maxima around noon of 0.1 $\mu g/m^3$, dropping 10-fold at night. They also found an average of 50% of the total Cl mass as gas-phase HCl.

In 2010, only PM_{10} was collected for dust loading and metal analysis. In 2011, $PM_{2.5}$ and PM_{10} sampling will be performed simultaneously using two 47 mm tared Teflon filters each with a SKC Leland Legacy sample pump with a constant airflow of 10 L/min. The internal flow sensor measures flow directly and acts as a secondary standard to constantly maintain the set flow. The volume display is continually updated, based on corrected flow rate multiplied by sampling time. The pump operation is controlled by

the CEM CO_2 trigger circuit. The SKC Leland Legacy Sample pump will be calibrated before and after the sampling campaign, with a Gilibrator Air Flow Calibration System (Scientific Instruments), which is a primary standard airflow calibrator.

PM will be measured gravimetrically as the difference between final and tare masses for each filter. The weighing of the filters will follow the procedures described in (40 CFR Part 50, 1987). Calibration for determining mass of conditioned media will be performed as described in Quality Assurance Guidance Document 2.12 (USEPA, 1998). The PM collected on Teflon filters will also be used to determine concentrations of target metals such as Pb and Al. EPA Compendium Method I0-3.3 (USEPA, 1999c) specifies the analysis by energy dispersive x-ray fluorescence spectrometry (EDXRF). This method is compatible with particulate on filters, is quite sensitive for metals, and is non-destructive. This means that the PM and substrate survive the analysis intact and may be archived or analyzed by other methods. Select PM samples from non-metal-containing propellants will be sampled for metals to determine whether the burn pans arere sources of residual metal carryover.

Carbon monoxide will be sampled continuously using a semi-real time monitor. An onboard CO sensor (Creative Solutions RCO1000) will measure CO concentration by means of an electrochemical cell through CO oxidation. Output is linear from 0 to 1000 ppm at an operating RH range of 15-90%. The RCO 1000 will be calibrated in the EPA Metrology Laboratory prior to departure at 0 to 100 ppm with +- 2 ppm error using EPA method 3A (2008). CO measured by flow through chemical cell will be corroborated by the measurement of a sample taken from the Summa canister system and analyzed via gas chromatography.

2010 Measurements

Other measurements conducted in 2010, such as VOC analysis (e.g., benzene) and SVOC analysis (e.g., naphthalene) will be repeated in 2011 tests. In general, emission factors determined in 2010 agreed well with published data. Additional tests in 2011 will serve the primary purpose of defining the range and variability of the sampling/analytical methods. These data will be useful if the DoD wishes to further establish methods that will be used in future regulatory- or permit-related testing.

One change to the 2010 analyses will be the inclusion of additional semivolatiles including nitroaromatic energetics. CAS (NY) will analyze for nitroglycerin (when present in the propellant) by high performance liquid chromatography (EPA Method 8332). Nitrocellulose can be analyzed by a total nitrogen method, but is probably not sufficiently sensitive for our samples, so will not be targeted. Additional commercial analytical sources are still being sought at the time of this writing. EPA will analyze for nitroaromatics (nitrotoluene and nitrobenzene) and PAHs by a EPA Method 8270. The method is modified by use of selective ion monitoring (SIM) with GC/LRMS to get lower detection limits, inclusion of nitrotoluene as a target analyte, and adjustment of the extraction volumes or dilution of the extract to get concentrations inside the calibration range. NitroPAHs will not be analyzed.

Ash

After each 6-pan burn series, the propellant ash will be collected and weighed. Samples of ash will gathered from the burn pans for each propellant type and analyzed for original constituent metals such as Pb and Ba and residual energetics. Non-Pb- and non-Ba-containing propellant ash will also be examined to ascertain the potential for carryover between propellants. Limited PM filters from non-metal-containing propellants will likewise be analyzed for metal carryover.

Test Matrix

Our plan is to sample approximately 18 burns per day (three series of six pans with 200 lbs each), providing for 300+ seconds of sampling per day (the 2010 average was 17 sec per burn). The order of the propellant testing is dependent on the arrival an availability of propellant at Tooele, which was still to be determined as of 3/12/2011. Table 3-4 of the original QAPP is amended as follows:

Day	Propellant	Pans*Wt	ClO_4, Cl, HCl	VOC, Summa	Semi-volatiles, PUF/XAD-2/PUF	$PM_{2.5}$, PM_{10}, metals	CO and CO_2
1	Type	Series*pans* weight	Field blank	Field blank	Field blank	Field blank	Background (upwind)
			Background (upwind, lofted)	Background (upwind, lofted)	Background (upwind, lofted)	Background (upwind, lofted)	Background (upwind, lofted)
2, 3	AP1	2*6*200 lb		**@ 12 Pans**	**X**	**@ 6 Pans**	**X**
		4*6*200 lb	**@ 6 Pans** (see below)		**X**	**@ 6 Pans, PM2.5 only**	**X**
4, 5	SB	3*6*200 lb	**NA**	**@ 12 Pans**	**X**	**@ 12 Pans**	**X**
		3*6*200 lb					**X**
6, 7	DB	3*6*200 lb	**NA**	**@ 12 Pans**	**X**	**@ 12 Pans**	**X**
	DB	3*6*200 lb					**X**
8, 9	TB	3*6*200 lb	**NA**	**@ 12 Pans**	**X**	**@ 12 Pans**	**X**
	TB	3*6*200 lb					**X**
10,11	AP2	2*6*200 lb		**@ 12 Pans**	**X**	**@ 6 Pans**	**X**
		4*6*200 lb	**@ 6 Pans** (see below)		**X**	**@ 6 Pans, PM2.5 only**	**X**
12,13	backup						
14	OD tests	Trial survivability tests for aerostat with shrapnel detonations					
15	cleanup						

AP1, AP2 = ammonium or potassium perchlorate (TBD) #1, #2; NA = not applicable; SB = single base; DB = double base; TB = triple base; OD = open detonation.

Cl Matrix for Each AP Propellant

Four six-pan series will be tested for primary analytes (bold) and secondary analytes using the cartridge and silica methods in parallel as follows:

	Cartridge Method			Silica Method	
# pans, wt	MCE filter	H_2SO_4-treated filter	Na_2CO_3-treated filter	MCE filter	Silica gel tube
6* 200 lbs	**Perchlorate**, chloride	–	**HCl,** perchlorate	–	**HCl**
6* 200 lbs	**Perchlorate**, chloride	**Cl_2**	**HCl,** perchlorate	**Perchlorate**, chloride	**HCl**
6* 200 lbs	**Perchlorate**, chloride	–	**HCl**	–	**HCl**
6* 200 lbs	**Perchlorate**, chloride		**HCl, HCl** (2 filters in series)	**Perchlorate**, chloride	**HCl**

The combination of these methods will allow us to compare the cartridge and silica methods for HCl (quantity and variance of data), determine perchlorate concentration and analyze for perchlorate vapor "slip" onto the Na_2CO_3 filter, evaluate chloride deposition on the MCE filter, look for HCl breakthrough, and evaluate the presence of Cl_2.

References

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U.S. EPA Compendium Method I0-3.3 (USEPA, 1999) analysis by energy dispersive x-ray fluorescence spectrometry (EDXRF).

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US National Institute of Occupational Safety and Health (1994) NIOSH Manual of Analytical Methods, 4th Edition Method 7903 Acids, Inorganic DHHS (NIOSH) Publication 94-113 http://www.cdc.gov/niosh/nmam/

Addendum #2 to:

Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance

2011 Cl Species Method Tests

Quality Assurance Project Plan
Category IV / Proof of Concept

June 21, 2011

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Introduction

This is an addendum to the QAPP entitled "Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance" relating to additional work scheduled for the Summer and Fall of 2011. In 2010 the Department of Defense's Strategic Environmental Research and Development Program (SERDP) awarded second year funding to further pursue development of methods for emission characterization of open burning of military propellants. This additional work focused on multiple propellant types including an ammonium perchlorate (AP) propellant with target analytes of perchlorate, chloride, and hydrogen chloride from the Cl-containing propellants. Methods for sampling these Cl-based analytes were derived from indoor and personal sampling methods and were covered in a previous addendum dated April, 2011. This field sampling was apparently successful, but the tests were limited in number. Further, the potential for breakthrough of the analytes could not be assessed based on the setup used at Tooele. The scope of this additional work relates to further testing of the same sampling methods detailed in Addendum #1. This additional testing will allow methods development with parallel samplers, control of flow rates, sample size, and simultaneous methods evaluation. The work on HCl testing will be done at the US EPA facilities at Research Triangle Park and the AP burns will be done at the U.S. Navy's Naval Surface Warfare Center (NSWC) in Indian Head, Maryland. The work at NSWC is being sponsored by the U.S. Army Defense Ammunition Center (DAC).

Schedule

June 24, 2011	Draft QAPP Addendum submitted to EPA with copies to U.S. Army DAC and NSWC
July 1, 2011	QAPP reviewed and approved.
July 12, 2011	HCl testing at RTP or AP testing at NSWC
August 8 or 15, 2011	Alternate date for AP testing at NSWC
October 7, 2011	Draft report/paper to DAC and to EPA review
November 30, 2011	Final report/paper

Method

HCl Sampling

Methods for sampling HCl are primarily derived from those intended for sampling inhalable HCl to relate to exposure risk. Methods consist of a filter method (ISO Method 21438-2) and silica gel tube method (NIOSH 1994). Tests done with HCl at the EPA's RTP laboratories will evaluate the sorptive capacity and breakthrough limits of an alkali-impregnated filter and silica gel methods.

HCl will be sampled in parallel using 1) alkali-impregnated filters following a solid perchlorate filter and 2) silica gel tubes as per Lindsay et al. (1999). HCl gas is expected to pass through the first perchlorate/chloride filter and be adsorbed by a second, quartz filter coated with Na_2CO_3. These coated filters are available in a cartridge from SKC Corporation. Any hydrochloric acid transiently collected on the initial filter is expected to rapidly evaporate and be collected along with the gaseous HCl (Howe, et al. 2006). This method, including the prefilter followed by a Na_2CO_3-impregnated quartz filter, is consistent with a method from France (INRS, 2002), as cited in Howe et al. (2006) and became a European standard method 2009 (ISO Method 21438-2).

Silica gel collection methods such as NIOSH Method 7903 (NIOSH 1994) may undersample HCl mist, as particle size collection characteristics on the silica gel sorbent tube do not match the inhalable convention (Howe et al., 2006). While there are considerable questions relating to the relevance of these methods to the inhalable particle/droplet size (Howe et al., 2006), our effort is more concerned with complete capture and quantification.

The NIOSH silica gel tube method is written based on flowrates of 0.2-0.5 L/min. Because of the brief time available to sample rocket plumes in the field, a faster volumetric sampling rate, up to 1.5 L/min, is desired. However, we need to test the breakthrough capacity in order to guard against falsely low measurements in the field.

The work covered here will involve feeding known concentrations of HCl gas through the filter cassette (SKC model 225-9005) and silica gel tube while measuring breakthrough versus flowrate and concentration. HCl gas will be metered via a mass flow controller and will target concentrations seen in the field during sampling (ca. 20 ppm). Feed HCl gas will be monitored at the beginning of the test and exit gas will be monitored throughout the test with the Bodenseewerk analyzer. These tests will determine the ability of the NIOSH method to extend to higher flowrates without breakthrough. A few tests will be monitored with Draeger diffusion tubes (1.3 – 200 ppm) in anticipation of their use at subsequent Indian Head tests. Test conditions are shown in the table below.

Table 1. HCl test matrix (work done at RTP, NC).

Method	Flow rate (L/min)	HCl concentrations (ppm)	Time (min)
ISO Method 21438-2, filter method	4	N2 only	1
	4	N2 only	5
	4	< 20	1
	4	< 20	5
	4	50	1
	4	50	5
	10	N2 only	1
	10	N2 only	5
	10	< 20	1
	10	< 20	5
	10	50	1
	10	50	5
NIOSH Method 7903, silica gel tube method	1.5	N2 only	1
	1.5	N2 only	5
	1.5	< 20	1
	1.5	< 20	5
	1.5	50	1
	1.5	50	5

Select filters may be analyzed for HCl by ion chromatography methods specified in EPA Method 26 as a check. These analyses will likely be performed by CAS (NY) as with the Tooele Year 2 samples; their limit of detection for this method is 4 µg/filter.

Perchlorate, Chlorate, Chloride Sampling

A single type of ammonium perchlorate (AP, over 65% by mass) propellant available at NSWC Indian Head will be tested in their facilities. A small amount (5 to 25 g) of AP will be burned in an enclosed, vented hood (see photo). The hood is approximately 48 ft^3 in size. Its emissions are vented to the outside. The emissions from the AP burn will be sampled by EPA with up to four samplers at once, testing the two different methods, the filter-based ISO method and the silica gel NIOSH method. The ventilation rate of the hood will be reduced during the burns to increase the residence time of the AP gases within the hood, allowing for greater capture by the samplers. The target analytes will include perchlorate, chlorate ion, HCl, and chloride salts. The samplers will be those used in the April 2011 Tooele testing (Figure 1).

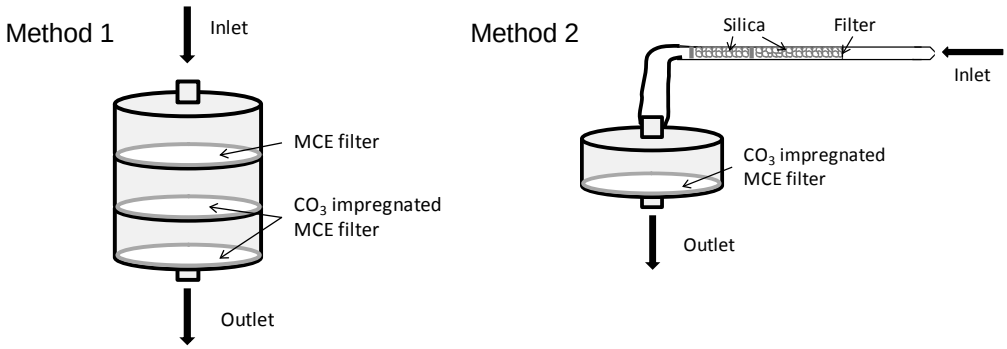

Figure 1. Sampling apparati for HCl, perchlorate, and chlorate. Method 1 (ISO 21438-2) followed by a second additional CO_3 filter at the left and method 2 (NIOSH 7903), followed by a CO_3 filter, at the right.

Perchlorate will be sampled using a modification of the method discussed in Lamm et al. (1999). The method consists of sampling at a flowrate of 2 L/min through a 37 mm mixed cellulose ester (MCE) filter (0.8 µm pore size) enclosed in a closed-face cassette (SKC Corporation). Perchlorate salts are captured as a solid on the filter, which assumes no perchloric acid formation. Cassette samples will be dissolved/extracted in

water, an internal standard added, and then analyzed for perchlorate with LCMS and for chloride with ion chromatography as per U.S. EPA SW-846 Method 6850. Samples will be analyzed at Columbia Analytical Services (CAS, NY).

The detection limit for perchlorate is cited as 0.004 µg/filter by CAS (NY). For the purposes of determining required sampling volumes and times to reach perchlorate detection levels, we used the chlorate ion emission factor derived at Tooele 2011, 1.0 E-06 g/g ClO3-. In order to reach 5 or 10 times the method reporting limit with a propellant size of 5 g we need to sample for 4 or 8 minutes, respectively, with a flow rate of 4 L/min. Table 2 shows the test matrix including the similarly calculated sampling times to reach 5 or 10 times the detection levels.

We also will sample for formation of HCl using the filter and silica gel tube methods indicated above during the Indian Head tests. HCl will be sampled in parallel using alkali-impregnated filters following the perchlorate filter and silica gel tubes as per Lindsay et al. (1999). HCl gas is expected to pass through the perchlorate/chloride filter and be adsorbed by a second, quartz filter coated with Na_2CO_3. These coated filters are available in a cartridge from SKC Corporation. This filter will be analyzed for HCl by ion chromatography methods specified in EPA Method 26.

Ambient air background levels will be determined for perchlorate, chloride, and HCl.

Table 2. Perchlorate, chlorate, and HCl Test Matrix

Method	Propellant amount (g)	Flow rate (L/min)	Time (min)	X ClO4/3 Det Limit
Lamm et al. (1999) and	5	4	4	5
ISO Method 21438-2	5	10	2	5
	5	4	8	10
	25	4	2	10
	25	10	1	10
	Background	4	60?	
	Background	10	60?	
NIOSH Method 7903	5	1.5	2	NA
	25	1.5	1	NA
	Background	1.5	60?	

Background sampling times to achieve the detection limit are unknown.
NA = HCl values only can be determined.

The combination of these methods will allow us to compare the cartridge and silica methods for HCl (quantity and variance of data), determine perchlorate concentration, analyze for perchlorate vapor "slip" onto the Na_2CO_3 filter, evaluate chloride deposition on the MCE filter, and look for HCl breakthrough.

The sampling times in Table 2 rely on our preliminary emission factors determined at Tooele in 2011 and so assume that the small scale AP tests at Indian Head will yield Cl species in a proportionate manner. Another confounding factor is the evacuation rate of the Indian Head chamber. To guard against these unknowns, CO2 will also be monitored in the Indian Head chamber to monitor pollutant depletion using the same Li-COR sampler as used at Tooele. Further assurance of the target levels inside the chamber will be determined qualitatively by monitoring HCl using Draeger diffusion tubes. The sampling times will be adjusted accordingly to achieve the desired ratio above the detection limit.

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Appendix D: Addendum #3 to – QAPP for WP-2233 Work

Third Addendum to:

Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance

2012 Open Detonation Tests

Quality Assurance Project Plan

Category III / Method Development and Measurements

May 30, 2012

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U.S. Environmental Protection Agency
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Introduction

This is a third addendum to the QAPP entitled "Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance" allowing for additional work scheduled for summer, 2012. The first addendum accommodated testing in 2011 and the second further specified Cl species measurement methods in the 2011 plan. The Department of Defense's Strategic Environmental Research and Development Program (SERDP) has awarded third year funding in 2012 to further pursue development of methods for emission characterization of open burning and open detonation of military munitions.

The objectives of this year's project are to develop methods to measure emissions from uncased and cased ordnance detonations for determination of emissions factors: CO2, CO, PM10, PM2.5, TSP, metals, VOCs, and SVOCs as well as to determine the impact of soil coverage and degree of soil wetness on emissions. Ordnance selection, soil coverage, soil wetness, and addition of measurements including Total SuspendedParticulate (TSP), energetics and their nitro-PAH byproducts, and continuous PM represent the departures from the original QAPP and its Addendums.

The ordnance for this effort will include uncased and metal-encased munitions as well as follow-up work on 2011 measurements of ammonium perchlorate (AP)-containing rockets. A further objective of this work is to determine the viability of the aerostat-based sampling method to successfully maneuver into, survive, and collect air emission samples from plumes potentially containing shrapnel from the casings and rock projectiles from the surrounding soils. The project results will: (1) provide DoD with a tool and methodology to estimate air emissions from soil-covered detonations, (2) provide valuable insight into factors impacting air emissions from soil-covered detonations, (3) address Open Detonation (OD) emission factor data gaps, and (4) provide initial scientific data to comply with environmental regulations and to proactively protect human health and the environment.

Tests commencing in June 2012 will primarily measure emissions during soil covered detonations. The method used will be a minor adaption of that used in 2010 and 2011 campaigns to account for the existence of near source shrapnel that can puncture the aerostat. All tests will be conducted at the Tooele (Utah) Army Depot test range, the site of the 2010 and 2011 tests.

Testing will include approximately 15 testing days and four munition types, including uncased, thick wall steel, thin wall steel, and AP-containing rocket motors and/or propellants (static fire and/or open burned propellant). The munitions will be buried to depths of 3 and 6 feet as well as covered with wet and dry soil. Charge size will comprise another test variable. These munition types were selected by the U.S. Army with criteria of ammunition stockpile quantity, the need for information on emission factors, and the presence of constituents in the ordnance for which emission data are needed.

Schedule

April 30, 2012	Draft QAPP Addendum submitted to EPA QA and to U.S. Army DAC
May 11, 2012	QAPP Review comments received
May 30, 2012	QAPP comments addressed
June 9, 2012, Saturday	Team arrives in Tooele, UT
June 11, 2012, Monday	Arrival at TEAD installation, set up for testing in Tooele
June 29, 2012, Friday	Testing complete
June 30, 2012, Saturday	Team departs Utah
October 28, 2012	Draft report to ERDC and DAC
November 28, 2012	Draft report in to EPA QA
December 28, 2012	Final report to SERDP

DAC = Defense Ammunition Center
TEAD = U.S. Army, Tooele Equipment Ammunition Division

Personnel

Personnel roles are mostly as previously described in the QAPP. EPA, NRC, and ORISE personnel will conduct the field sampling. ARCADIS personnel will provide logistical support, but no analytical support is envisioned for this effort. Dennis Tabor (EPA) is in charge of the analytical measurements and quality assurance.

Test Materials

Four Propellant, Explosive, and Pyrotechnic (PEP) materials, two AP propellants, and one AP rocket motor will be available for OD, Open Burning (OB) and static firing, respectively. These propellants and their composition are listed in Table 1. This table is a replacement for Table 3-1, "Composition of OB and OD Ordnance," in the original QAPP. Note that the relevant elemental composition of the metal casings and the donor charges have not been included in Table 1. These data will be combined with Table 1 when provided by the U.S. Army. These PEP compounds were selected and ranked in priority by the U.S. Army's Defense Ammunition Center (DAC) for this work because of the ammunition stockpile information, uncertainties and/or data quality issues associated with the EFs in the draft Chapter 16 OB/OD emission factor database, and uncertainties in the sampling methods. Charge sizes in 2012 will be varied, with a maximum of 300 lbs, pending acceptable meteorological conditions. It is anticipated that up to about two series of five detonation tests can be done per day. Two ammonium perchlorate (AP) propellants currently on site at TEAD will be burned in open pans and, if available, AP-containing rockets will be sampled under static fire conditions at the Tooele Production Range. Data from these propellant tests will supplement initial data taken in 2011. The plumes from the static firing of these rocket motors and/or AP propellant burns will be sampled for perchlorate, HCl, and chloride salts as well as other pollutants as per QAPP Addendum #2 and detailed in Table 4.

Table 1. Composition of the PEP Test Materials										
DODIC	Description & (NSN)	Casing Material	Weight (%)						NEW (lb)[@]	GWT (lb)
			RDX	TNT	HMX	C	Other	AP		
None	Comp B	None	60	39	-	25.02	-		60	60
V453	WHD GM MK90, H6 fill, (1336003989993)	Thick-wall steel	45.1	29.2	-	22.12	Al:21		65	141
V548	WHD Section GM HE WAU-17B (Sparrow), (PBXN-3 fill), (1336011292305)	Thick-wall steel	0.32	-	85.67	22.85	Pb:0.0235, Si:Ca:trace		35.43	86.1
K180	M15 AT Mine, Comp B fill, (13450002851180)	Thin-wall steel	60.02	38.95	-	25.01	Pb:0.004, Cl, Sb, K, S		22.78	31.46
ARC 452A*	Arcadene	None	-	-	-	9.42	Al:19, Cl:20.82, Fe:0.7	69	54	
ARC 451*	Arcadene	None	-	-	-	9.69	Al:19, Cl:20.82	69	54	
V890	Propulsion Section GM WPU-5/B (ANP 3146-2 and ANP 3196-1 Propellants)	None	-	-	-	12.25	Al:5.88, Cl:19.81, Cu:0.41, Cr:0.34	65.66	96.52	152.5

* Information obtained from AEROJET MSDS
[@] Does not include donor.
PEP = propellants, energetics, pyrotechnics
NSN = NATO stock number
NEW = net explosive weight
GWT = gross weight
DODIC = Department of Defense Identification Code
V453 has a 9 lb shaped charge of 8.6 lbs Zr and 0.4 lbs Hf

New Target Analytes, Methods, and Calibrations

Emissions

Analytes included in this amendment and specified in the original QAPP, Section 3.2 "Analytes and Process Measurements," will include CO2; PM2.5; PM10; and VOCs, CO, and CO2 from SUMMA canisters. Analytes also included in this work from QAPP addendum #2 will include HCl, chlorates, ammonium perchlorate, and chlorides. New measurements for this Addendum (#3) include an increased focus on particles, the distribution of metal emissions through the particle sizes, and residual energetics. Two methods of Total Suspended Particulate (TSP) measurement have been added by expanding the analytical methods for PM collected in the inertial impact samplers and semi-volatile filter. These

samples will provide information on the distribution of the PM and metals across particle-size categories of environmental interest (TSP, PM10, and PM2.5). The semivolatile method cited in the original QAPP will now focus entirely on energetics. It has been modified to exclude the post-filter PUF on the advice of DAC, as previous results have shown the energetics to principally particle-bound and this will afford a higher collection rate.

Particulate Matter

Addition of a dedicated particle size sampler for TSP and its sampling pump are weight-prohibitive. To accommodate this constraint, one TSP measurement will be combined with those for PM2.5 and PM10. The TSP measurement will consist of the weight gain on a solid surface, circular disk. The candidate for these disks is the spacer that comes with the 37 mm filters. This disk will be placed on the impactor plate of the PM10 or PM2.5 cartridge; the weight gain of the disk and the downstream filter will amount to the TSP mass. This method is referenced in the manufacturer's manual, SKC #38010.pdf, "Performance Profile," and discussed face to face with SKC laboratory representatives at a recent conference, although the manual refers to this method for the application of TSP chemical analysis. To adapt this for gravimetric application, we'll bypass the manual's suggestion of a quartz or PTFE filter in favor of the 37 mm filter spacer. Filters have porous, non-smooth surfaces which can trap particles rather than acting as an impactor surface. The spacers, however, will provide a smooth surface enabling particle "bounce" without sacrificing the function of a solid impactor surface.

In addition to the SKC cartridge modification, the 10"x 8" quartz filter on the energetics semi-volatile sampler will be preweighed in the field under ambient conditions on the day of use. After sampling it will be reweighed in the field laboratory, folded in half, placed within a doubled aluminum foil sleeve and shipped to ALS Labs (Kelso, WA) for energetics analysis. The weight gain on the filter will provide a check against the SKC TSP weight. ALS has advised that the filters do not need to be kept cool during shipment, consistent with the relatively non-volatile nature of the explosive.

In addition to the TSP measurements, a continuous PM analyzer (DustTrak DRX Aerosol Monitor model #8533) will be employed. The instrument has the capability of simultaneous real time measurement (every second) of PM1, PM2.5, PM10 and Total PM. Concurrently, an enclosed, 37-mm pre-weighed filter cassette provides a simultaneous TSP gravimetric sample. The total flow rate is 3 L/min where 1/3 of the flow rate is used for the continuous measurements and 2/3 is used for the gravimetric sample. A custom calibration of the DustTrak 8533 will be conducted as per manufacturer's recommendations (Appendix B of http://www.tsi.com/uploadedFiles/_Site_Root/Products/Literature/Manuals/8533-8534-DustTrak_DRX-6001898-web.pdf) using an external gravimetric sampling device. In our case, these external devices will be the PM2.5 and PM10 SKC cassettes. The mass concentration from this PM2.5 gravimetric measurement and the measured flowrate is compared to the 8533 measurement, creating a new photometric calibration factor, PCF_{NEW}. This factor is applied to scale the real time data. Similarly, use of an external gravimetric PM10 impactor allows determination of a size calibration factor, SCF. A zero calibration will be performed before each day using a zero filter which comes with the DustTrak DRX and a flow calibration will performed before each day with a Gilibrator flowmeter, following procedures in Operation and Service Manual Model 8533/8534 (P/N 6001898, Revision F, January 2011). The DustTrak inlet will be cleaned after each use/day by a cotton swab, and the internal filter will be replace when indicated by the main screen filter error indicator on the DustTrak.

Metals by Particle Size

The TSP impaction plate and the PM10 and PM2.5 filters will be analyzed for metals listed in Table 9. Select filters only and select metals only will be analyzed, such that not all of the filters and all of the metals will be analyzed. The criteria for selection will be those filters and metals sufficient to establish reproducibility of emission factors, those metals within the subject PEP/casing, and establishment of background metal concentrations from the Tooele soil. Analyses will be conducted via preparatory method 3050b and analytical method 6020 incorporating ICP/MS as in the original QAPP. The filters will be made of PTFE. Of particular note is the metal analysis for Zr and Hf with V453. V453 contains a 9.0 lb shaped charge comprised of a Zr/Hf alloy (8.6 lb Zr, 0.4 lb Hf), elements which are uncommon for ordnance and not expected in the TEAD test site soil, allowing for characterization of the percentage of the Zr/Hf alloy that enters the detonation plume. For reference, Tritest, Inc. lists their Hf detection limit of 0.0025-0.0500 mg/kg for a 0.5 g filter-bound sample. The filters and impactor plate will be subject to blank analyses.

Energetics and Their Byproducts

Additional new analytes this year include semi-volatiles of residual energetics and nitro-PAHs [Note, as of 4/13/12 no lab had been found that could do the nitro-PAHs]. These will replace target semivolatile analytes of past years (e.g., naphthalene). These will be sampled as in the original QAPP using the large fan (1200 L/min) to pull the plume exhaust through a large quartz filter but without a following sorbent. These procedures are consistent with past energetic sampling at Dugway Proving Ground (U.S. Army, 1992) that reason minimal losses, if any, of volatile targets while maximizing sample volume.

Target residual energetics will include:

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, “HMX, ” CAS #2691-41-0
Hexahydro-1,3,5-trinitro-1,3,5-triazine, “RDX,” CAS #121-82-4
2,4,6-Trinitrotoluene, “2,4,6-TNT,” CAS #118-96-7
Nitro-PAHs [see note above].

As mentioned above, the 10”x8” quartz filter will be preweighed in the field under ambient conditions on the day of use. After sampling it will be weighed in the field, folded in half, placed within an aluminum foil sleeve and shipped to ALS Labs (Kelso, WA). The analytical procedure to be followed is Method 8321 (although the target analytes are those covered in Method 8330). ALS Labs will remove the filter, fold it into thirds, roll it up, place it into a 40 mL glass vial, spike it with internal standards (1,3-dinitrobenzene-d4), add acetonitrile, agitate the vial, remove the acetonitrile, concentrate by nitrogen blowdown, dilute with acidified water for matrix matching, and then inject. The target compounds’ area will be analyzed with a combination instrument using both UV absorption detection and then a triple quad mass spectrometer. Compounds at high concentration or low MS sensitivity are quantitated by UV and the remaining compounds are quantitated by MS/MS. The mass is then quantified using the response factor, and the measured target concentration in ratio with the known standard concentration. The residual extract will be returned to EPA labs and will be available for nitro-PAH analysis (pending identification of an analytical laboratory).

Other Samples

As in the original QAPP, background air samples will establish levels of targets including energetics, PM, carbon, and nitro-PAHs (pending identification of an analytical laboratory).

Soil

Sampling of soil is being added to this year's QAPP. Soil sampling will be conducted both before the onset of detonations, in the middle of the project, and after the conclusion of the project's sampling. The purpose of soil sampling is to provide background concentration levels of target analytes to compare with emission sampling. In this manner, the contribution of residual energetics and metals in the soil to that of the emissions can be assessed.

Metals and energetic concentration in the soil (mass target/mass soil) will be compared to their counterparts sampled at the Flyer. A concentration ratio between both will determine the level of contribution of the contaminated soil to that of the Flyer sample. If the Flyer to soil ratio is high, it can be concluded that the soil's prior contamination provides minimal input into the emissions. Conversely, a low ratio indicates that the soil's contamination contributes substantially to the observed concentrations in the emissions. While the emission values could be corrected for the contribution of the soil contamination, it's not envisioned that the number of planned replicates will provide sufficient confidence in this analysis.

The soil sampling method was derived from a QAPP to determine soil nitrogen from a highly spatially and temporally variable agricultural field after fertilization (Walker et. al, 2006) with consideration of standard operating procedures for range sampling (Appendix A of Hewitt et. al, 2007). Soil samples (0 – 15 cm depth) will be gathered using standard techniques (Walker et. al, 2006) from random locations along transects extending to the north, east, south, and west of the center of the detonation area. Transects will be flag- marked. Transect lengths will be approximately 100 m in length from the centerpoint. Five (5) samples will be taken from 1 m^2 areas along these transects prior to campaign detonations, five (5) during the campaign, and five (5) after completion of the campaign. For each of the five locations, triplicate samples will be taken within a 1 m^2 area via a 5 cm coring device at each location and composited within a plastic bag to form a single sample. Two people will do the sampling, one to do the coring, the other to hold the polyethylene zipper bag. Sample size will be determined through consultation with the laboratory as will the mixing, coning, and quartering to produce a homogeneous sample for analysis.

Two samples from each composite 5-sample survey (before, during, and after detonations, total 6) will undergo energetic and metal analysis. Samples will be analyzed for metals (Zr, Hf, Al, Fe, Bi, Mn) using U.S. EPA Compendium Method IO 3.4 (1999) acid digestion followed by ICP, Method 200.7, and energetics as per Section 11.1.4 of Method 8330A for nitroaromatics using (http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/8330a.pdf). Additional soil-specific constituent metals will include Si, Na, Ca, and Mg in an attempt to distinguish soil mass from energetic mass.

This limited soil sampling plan may prove insufficient to fully characterize the very heterogeneous nature of the soil contamination at Tooele. The site has been subject to recent earth-moving in preparation for this testing, including construction of a natural berm. In addition, the testing itself may gradually contribute to soil contamination throughout the course of the campaign. These soil results will be complemented by collected PM analyses during the Comp B testing. As Comp B has no metals, the only metals present will include those from the surrounding soil. Together, the soil samples and the Comp B analyses will provide an assessment of the anticipated soil contribution to subsequent testing and will provide information on the efficacy of soil sampling in future efforts to characterize soil contributions.

Test Procedures

All encased munitions (that is, all munitions except for Comp B and AP) will be detonated with either 3 ft or 6 ft of soil cover. Munitions will be placed in 3-ft holes and covered to ground level (soil cover "3" ft under-

ground, see Table 2). Whether these are placed on the ground surface and then covered with soil or placed in 3 to 6 ft holes with soil cover totaling 6 ft ("6") as per hole of desired depth is a matter to be determined by experts at TEAD. Comp B, which is comprised of some of the same energetics in the encased munitions, will also be detonated at ground level and under 6 feet of cover to understand the emissions from an uncased munition. An additional variable for limited tests, pending available time, will be the presence of a wetted soil cover. A known amount of water (or flow rate and time) will be sprayed atop the soil cover. This procedure and operation will be planned and conducted by TEAD and will be based on procedures used at TEAD or other installations. Further, placement and ignition of the HE test items are the sole responsibility of the Tooele facility.

The first day on-site will include unsampled trial detonations of each ordnance type to observe plume behavior including height and shrapnel/rock throw. Smoke grenades and small balloons will also provide visual evidence of both ground and aloft winds, respectively. Likely a small (5' diameter), "sacrificial" balloon will be lofted to determine distance versus shrapnel hazard. Soil samples will be collected before these trial detonations to determine background concentrations in the soil. These tests will be observed, photographed, and video recorded to provide a basis for initial placement of the aerostat and ATV-mounted winches during actual testing.

Detonation plumes will be sampled as in the original QAPP by downwind pre-positioning of the aerostat/Flyer and then repositioning based on plume direction. Smoke grenades and small balloons will also provide visual evidence of both ground and aloft winds, respectively. The small balloons will be filled to varying amounts with helium to achieve observations of winds throughout a vertical transect. The initial downwind position will be extreme to limit the chance of shrapnel damage. With experience, the downwind distance may be shortened. Movement of the aerostat after the detonation will be accomplished by aid of line-of-sight, radio-controlled winches mounted on each ATV. These radio controlled winches have been tested to a distance of 2500 ft. These winches can be controlled simultaneously by the aerostat pilot. Positioning of the plume and aerostat is accomplished by both the pilot and an observer, both in radio communication and orthogonal to each other. This year a third, remote-controlled winch and tether system will be added to maximize our ability to adjust the aerostat orientation during plume flow. This third winch will allow for vertical adjustments deviating from the plane created by the balance of the aerostat's loft and the pull of the two tethers. This will change the possible range of aerostat positions from a 2D triangle to a 3D cone. Personnel will evacuate the detonation area to a location and distance at the direction of TEAD staff.

Exceeding sampling and analytical detection limits is a conundrum for processes in which the emission factors are absent or of considerable uncertainty. To understand the sampling parameters (volume, time, mass) necessary for energetic sampling and analysis, a range of published emission factors were coupled to the probability of sampling success and analytical laboratory detection limits. Estimates of the maximum and minimum quantities of energetics in the plume that can be sampled were derived by multiplying the detonation mass by the minimum and maximum EFs in Table 1 (Summary Statistics for OD Emission Data Sets) in Recommended EFs for Estimating the Air Emissions for OB and OD, March 31, 2011. It was assumed that the range in possible emissions covered both surface and buried detonation events. (There are no EFs for PM-2.5 or TSP.). The sampling success rate was taken from the carbon collection efficiency during the sparrow rocket motor firing in 2011, deemed the most comparative sampling scenario. The carbon collection efficiency was 0.043% (0.05 g C sampled by the Flyer out of 10.6 lbs C in the sparrow propellant). Multiplication of the carbon collection efficiency by the maximum and minimum anticipated detonation mass yields the high and low of anticipated analyte collection. These values were then compared against the laboratory's detection limit to understand the probability of sampling success. ALS (Kelso, WA) indicates that their detection limit is 10 ng/sample for TNT. This DL will be about 5 to 15 times more sensitive than the existing, estimated maximum emission factor, subject to the assumptions regarding sampling efficiency noted above. The carbon collection efficiency can be monitored and calculated in the field and will

assist in determining each day whether additional sampling is necessary to meet or exceed the 2011 precedent.

Table 2. OD Test Matrix and Analytes

Test Item[1]	Total Number of Det'ns	Total Number of Items in Each Det. Pile	Det'n Pile NEW (lb)	Soil Cover (ft)	PM & Metals by Filter		PM-1, -2.5, -10, -Tot by CEM	Energetics & Nitro-PAHs	CO, CO2, VOCs by Canister	CO2 by CEM
					TSP/PM-10 + Metals	TSP/PM-2.5 + Metals				
Comp B @ 60 lbs	4	5	300	0	1	1	1	0	1	1
	4	2	120	0	1	1	1	1	1	1
	4	5	300	0	1	1	1	0	1	1
	4	2	120	3	1	1	1	1	1	1
	4	5	300	3	1	1	1	0	1	1
	4	5	300	6 (dry)	1	1	1	1	1	1
	4	2	120	6 (dry)	1	1	1	0	1	1
V453 @65 lbs	4	3	195	6 (dry)	1	1	1	0	1	1
	4	5	325	6 (dry)	1	1	1	1	1	1
	4	3	195	3	1	1	1	0	1	1
	4	4	260	3	1	0	1	1	1	1
	4	3	195	6 (dry)	1	1	1	1	1	1
	4	5	325	6 (dry)	1	1	1	1	1	1
V548 @ 35 lbs	4	3	106	3	1	1	1	1	1	1
	4	8	280	3	1	1	1	1	1	1
	4	3	106	6 (dry)	1	1	1	1	1	1
	4	9	320	6 (dry)	1	0	1	1	1	1
K180 (tank mine)	4	5	114	3	1	1	1	1	1	1
	4	13	292	3	1	1	1	0	1	1
Comp B	4	5	300	6 (wet)	1	1	1	0	1	1
	4	5	300	6 (wet)	1	1	1	1	1	1
K180	4	5	114	3	1	1	1	1	1	1
	4	13	292	3	1	0	1	1	1	1

Note 1. This is sampling matrix is in a suggested order which may be modified based on local considerations such as ordnance availability, initialization charge availability, and the Production Range availability for AP rocket motor testing. The priorities for sampling are sufficient replicates and cover depths to characterize an ordnance type. If necessary, composite samples with varying charge size can be obtained.

Test Procedures – Ammonium Perchlorate-Containing Propellants: Static and Pan Fires

As in 2011, sampling of ammonium perchlorate-containing rockets will follow procedures as in Amendment #1 with the exclusion of SVOC sampling. Three series of 8 to 10 rockets will be targeted for sampling as per Table 3 over two days. If weather or circumstances prevent sampling of static fires, pan burns of AP propellant will be undertaken as per the original QAPP procedures for open burning of propellant. Pending the loft capacity of the aerostat, the PM10 pump and filter as well as the VOC SUMMA canister will be removed to allow for simultaneous HCl method pump sampling.

Table 3. Type and Number of Samples for AP Fires.

	Sparrow Rockets			Open Burning		
Target Analyte	**Series 1***	**Series 2**	**Series 3**	**Series 4#**	**Series 5**	**Series 6**
CO2 continuous	X	X	X	X	X	X
PM continuous	X	X	X	X	X	X
PM2.5, 10, TSP	X	X	X	X	X	X
Metals on TSP	X	X	X	X	X	X
Filter Method, ISO 21438-2						
Chlorides from PM	X	X	X	X	X	X
HCl	X	X	X	X	X	X
Perchlorate	X	X	X	X	X	X
Chlorate	X	X	X	X	X	X
Silica Method, NIOSH 903						
Chlorides from PM	X			X		
HCl	X			X		

*Each series is assumed to consist of 8 or more rockets.

#Each series is assumed to consist of multiple pan burns with charge sizes in multiples of 54 lbs.

Data Quality Indicators

Section 5, Quality Assurance, Quality Control of the original QAPP is amended with Table 4 below.

Table 4. New Analyte Data Quality Indicators

Measurement Parameter	Analysis Method	Recovery/Accuracy	Detection Limit	Completeness %
RDX, HMX, TNT	Method 8321, Filter extraction w/ acetonitrile, acidified water, HPLC/UV and HPLC/MS/MS	Not Available	10 ng/sample	75%
Metals (Al, Hf, Mn, Fe, Zr, Bi)	Method IO 3.4 (1999) acid digestion followed by ICP, Method 200.7	80-120% recovery	0.02-5 mg/kg[1]	75%
Nitro-PAHs	TBD	TBD	TBD	75%
TSP	Gravimetric, Method in App. B of 40 CFR 50	Precision is 2 SDs of a triplicate weight	10 µg	90%

[1]the detection limit is dependent on the target compound and the weight of the filter.

Calculations and Data Presentation

Emission factors will be the primary output of this work. The carbon balance method will be used to determine emission factors. Emission factor data will be calculated using the compositional data provided in Tables 1-2. Tables 6-14 below provide the template for data reporting.

Table 5. Sampling Success.

	HE #1	HE #2	HE #3	HE #4	AP-static	AP-OB
No. of detonations						
No. of hits						
Hits (%)						
Avg Sampling time (s)						
ΔCO2 (ppm)						

Table 6. VOC Results

	HE #1 to #4, AP #1 to #2*		
	Avg	N	SD
ΔCO2 (ppm)			
ΔCO (ppm)			
Benzene (lb/lb C)			
Toluene (lb/lb C)			
Ethylbenzene (lb/lb C)			
Xylene (lb/lb C)			
Etc.			

*VOCs for AP are dependent on the payload capacity

Table 7. SVOC Results, Emissions

	HE #1 to #4,		
	Avg	N	SD
ΔCO2 (ppm)			
RDX (lb/lb C)			
TNT (lb/lb C)			
HMX (lb/lb C)			
NitroPAHs (lb/lb C)			

Table 8. PM Results

	HE #1 to #4, AP #1 to #2		
	Avg	N	SD
PM2.5 (lb/lb NEW)			
PM10 (lb/lb NEW)			
PreImpactor (lb/lb NEW)			
TSP (lb/lb NEW)			

Table 9. Metal Results, Emissions

		PM2.5 (lb/lb metal)						
HE #1 to #4, AP #1 to #2		C	Al	Hf	Zr	Fe	Mn	Bi
	Avg							
	N							
	SD							
		PM10 (lb/lb metal)						
		C	Al	Hf	Zr	Fe	Mn	Bi
	Avg							
	N							
	SD							
		TSP (lb/lb metal)						
		C	Al	Hf	Zr	Fe	Mn	Bi
	Avg							
	N							
	SD							

Table 10. HCl, particulate chlorides, perchlorate, and chlorate concentrations from AP #1 and #2

Sampling method		PM Chlorides (mg/m3)	HCl (mg/m3)	HCl (ppm)	ClO4- (mg/m3)	ClO3- (mg/m3)
Filter, ISO 21438-2	Avg					
	N					
	SD					
Silica, NIOSH 7903	Avg					
	N					
	SD					
MRL						

Table 11. HCl, perchlorate, and chlorate emission factors from AP#1 and #2

Sampling method		HCl	ClO4-	ClO3-
Filter, ISO 21438-2 (lb/lb NEW)	Avg			
	N			
	SD			
Filter, ISO 21438-2 (lb/lb Cl)	Avg			
	N			
	SD			
Silica, NIOSH 7903 (lb/lb NEW)	Avg			
	N			
	SD			
Silica, NIOSH 7903 (lb/lb Cl)	Avg			
	N			
	SD			

Table 12. SVOC Results, Soil (wt %)

		RDX	TNT	HMX	NitroPAHs
Pre-, During, and Post-Detonation Samples	Avg				
	N				
	SD				
	SD				

Table 13. Metal Results, Soil (wt %)

		Carbon	Al	Hf	Zr	Fe	Mn	Bi
Pre-, During, and Post Detonatio n Samples	Avg							
	N							
	SD							

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Appendix E: Addendum #4 to – QAPP for WP-2233 Work

Comparison of OBODM Predictions with Aerostat-Based Field Measurements

Quality Assurance Project Plan Addendum #4
Category IV / Measurement

A QAPP addendum: **Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance (ca. March 2010)**

June 2012

Comparison of OBODM Predictions with Aerostat-Based Field Measurements

Quality Assurance Project Plan Addendum #4
Category IV / Measurement

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1. Project Description and Objectives

This is a QAPP addendum (#4) for measurements intended to provide initial verification of OBODM (Open Burn Open Detonation Model), a dispersion model used to predict downwind concentrations of pollutants from open burning and open detonation of obsolete and hazardous military munitions. This addendum adds additional aerostat- and ground-based meteorological measurements which will be compared with predictions from OBODM. These measurements are part of the larger project, "Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance" approved ca. March 2010.

1.1 Project Description and Objectives

OBODM is used by DoD to initiate prediction of downwind pollutant dispersion and deposition from ordnance disposal operations. These resultant predictions are used to determine Health Risk Assessments for the disposal facility during the environmental permitting process. OBODM (1) predicts plume height and diameter, taking into account plume rise due to the intense energy released by the propellants and explosives within the munition, as well as point concentrations versus downwind position in x,y,z coordinates. Output data from OBODM are used in other models, such as AERMOD, to more fully predict downwind concentrations, pollutant dispersion, and deposition. AERMOD is a relatively new model which takes into account wet and dry deposition, as well as terrain and meteorology, predicting human and ecological exposure. However, the OBODM predictions have not been validated by near source, aerial sampling.

Under an ORD/OSIM funded project through EPA's National Computer Center (Heidi Paulsen, STOCOR) with Lockheed Martin has unearthed and resuscitated the original Fortran code in OBODM and made it usable on current computational platforms. Additionally, the source code has been edited and recompiled (see section 3.1) to provide time series concentration data at specific downwind positions for comparison with experimental data.

In this QA Addendum, we propose to compare OBODM concentration predictions of CO2 with actual aerial measurements. CO2 will be used as a surrogate for all pollutants from the detonations, as CO2 is easily measured in real time. Use of aerial sampling methods to determine pollutant concentrations have been demonstrated at two field campaigns in 2010 and 2011 at the Tooele Depot. OBODM predictions will be compared with measurements from the aerostat's Flyer.

2. Project Organization and Responsibilities

2.1 Personnel

Dr. Brian Gullett, the EPA principal investigator, has overall project responsibility including data quality and personnel safety. Dr. Johanna Aurell, an NRC post doctoral researcher, has responsibility for the technical data collection and data analysis. Mr. Chris Pressley, EPA electronics technician, has responsibility for the field power and electronics functioning. Dr. Will Stevens, ORISE post doctoral researcher, will develop and manage the interface software as well as coordinate ground and aerostat based meteorological measurements. Matt Freeman, a contractor for Lockheed-Martin will assist with OBODM model predictions through EPA project officer Heidi Paulsen. Aerial operations will be headed by Mr. Robert Gribble, ISSI, Inc., through a directly funded effort by Strategic Environmental Research and Development Program (SERDP). Mr. Ryan William, U.S. Army Defense Ammunition Center (DAC), as the main data user, serves as the DoD coordinator and project overseer.

2.2 Project Schedule

Table 2- 1 Project Schedule

Date	Task
Monday, May 25, 2011	Completion of QAPP to allow field measurements
Monday, June 11, 2011	Field Tests commence
Friday June 29, 2011	Field tests are completed
Friday July 27, 2011	Real-time data are analyzed and reduced.

3. Testing overview

3.1 Descripiton of OBODM Modifications

This section describes modifications made to the OBODM model for the purpose of computing average concentrations over a user-specified time interval. The original OBODM source code was downloaded from the EPA's atmospheric modeling website: http://www.epa.gov/scram001/dispersion_alt.htm

3.1.1 Original OBODM calculations

The dosage D at an arbitrary (x,y,z) location is calculated in OBODM by integrating the concentration function, χ over a specified time interval :

$$D(x,y,z) = \int_{t_1}^{t_2} \chi(x,y,z,t')dt' \qquad (3\text{-}1)$$

The average concentration over the same time interval is simply the dosage divided by the integration time:

$$\textit{Average concentration} = \frac{D(x,y,z)}{\int_{t_1}^{t_2} dt'} \tag{3-2}$$

In the original code, the user could not control the integration limits, making it difficult to compare the OBODM results to concentration time histories measured in the field. Instead, the limits were automatically computed as follows:

$$t_1 = \frac{x - 2.45\,\sigma_x}{\bar{u}} \tag{3-3}$$

$$t_2 = \begin{cases} \dfrac{x + 2.45\,\sigma_x}{\bar{u}} & ;\ \text{instantaneous source} \\ \tau + \dfrac{x + 2.45\,\sigma_x}{\bar{u}} & ;\ \text{quasi - continuous source} \end{cases} \tag{3-4}$$

where $\bar{u}$ is the mean wind speed and σ_χ is the along-wind dispersion coefficient.

3.1.2 Modified OBODM calculations

The code was modified so that the integral limits t_1 and t_2 can be arbitrarily specified by the user in the OBODM input file (*.INP). The text output of the code was also modified to verify that the limits were applied correctly. The following table shows a list of the FORTRAN files that were modified, and a short summary of the modifications:

Table 3- 1 Modifications to original OBODM FORTRAN code.

File	Modification

OBODM.FOR	Declare and initialize new variables:
	
	`double precision mjf_dosage_t1, mjf_dosage_t2`
	`common mjf_dosage_t1, mjf_dosage_t2`
	`mjf_dosage_t1 = 0.0`
	`mjf_dosage_t2 = 5.0`

RINDA.FOR	Read integral limits from input file:
	
	`common mjf_dosage_t1, mjf_dosage_t2`
	`READ (igtfil,*) mjf_dosage_t1, mjf_dosage_t2`

RMDLB.FOR	Set existing integral limits (ts, te) to user-specified values, and write them to the output file:
	
	`common mjf_dosage_t1, mjf_dosage_t2`
	`ts = mjf_dosage_t1`
	`te = mjf_dosage_t2`
	`write(iotfil,8891) ts`
	`8891 format ('MJF ts = ', e15.7)`
	`write(iotfil,8892) te`
	`8892 format ('MJF te = ', e15.7)`

The code was recompiled with MS-FORTRAN 5.1, which is the same compiler that was used to compile the original code. The new code was tested to ensure that the modifications did not affect the dosage results compared to the unmodified version. This was accomplished by manually computing the integral limits using the equations given above, and passing them into the modified code. The computed dosages in both the modified and unmodified versions of the code were found to be identical.

3.1.3 PROCEDURES FOR EXECUTING MODIFIED OBODM

1.) Input files for Modified OBODM are identical to input files for the original model with the exception that the first line contains two integer values corresponding to t_1 and t_2 separated by a space.

2.) Modified OBODM must be executed using the batch file interface. Batch files consist only of the filenames of each input file to be executed. Filenames must consist of 8 characters followed by a '.' and a file extension of 3 characters. The batch file format is such that one filename is on a line. Each line containing a filename is separated by 4 blank lines.

file001.inp

file002.inp

…

File00n.inp

3.) The interface for modified OBODM is identical to the original. Batch files are executed by entering the batch file name and extension into the input file field in OBODM preceded by a '=' character.

4.) Output files from modified OBODM are identical to the original.

3.2 Experimental Design

The purpose of this work is to assess OBODM output predictions of downwind characteristics of plumes (height, diameter, and CO2 concentration) generated from the combustion of propellants and detonation of explosives with corresponding field measurements. Field measurements will fall into two categories, meteorological measurements for model input and pollutant concentration measurements for comparison with model output.

Plumes will be sampled/measured from two different ordnance type scenarios. These scenarios are described more fully in Addendum 3 of this QAPP. The first of these scenarios is that of static firing of ammonium perchlorate-containing rocket motors at the Tooele Production Site, as was done in the 2011 campaign. At least 30 of these motors are believed available for static firing, pending appropriate timing and meteorological conditions. The second scenario is open burning of ammonium perchlorate propellant at the Tooele Test Site, as was done in the 2010 and 2011 campaigns. Approximately six burns are planned. A potential third and last scenario would involve plume sampling/modeling from the open detonation of Comp B. This scenario is more difficult due to standoff requirements and the potential for rock throw, but will be considered if the other two scenarios prove unlikely or insufficient.

Aerostat-based pollutant measurements will be made as in the main QAPP ("Determination of Emission Factors from Open Burning and Open Detonation of Military Ordnance") and its Addendums (#1-3) . A simultaneous measurement with a second aerostat will include GPS and CO2 concentration measurements, thus providing two downwind reference points from which to verify the OBODM predictions. The second aerostat will be positioned nominally downwind of the source and downwind of the primary aerostat. It will be unable to be moved during the plume generation. If possible, a third aerostat will be lofted for additional simultaneous data of CO2 and position. Assuming minimal or no wind shifts and a reasonably sufficient initial height for the pre-positioned

second aerostat, the system will capture the plume and record CO2 concentration and GPS position. Concurrent measurements of meteorological values will provide input data for running the model and will be acquired from the ground, a 10 m mast, and on board the aerostat(s).

Output from the OBODM can be acquired using different complexity levels of meteorological data input. At the lowest level of complexity, only the Pasquill stability class and 10 m wind velocity are required to generate output.All other input parameters are estimated from these values and default parameters. The model is presumably more accurate when empirically derived values for turbulent intensity and mixing layer depth are used rather than those estimated from the Pasquill stability class by OBODM. The level of input (and the associated level of effort) should therefore be related to the quality of OBODM output. However, some inputs are prohibitive to measure and may not be possible to acquire for all OBODM users. Because of this, different outputs from OBODM will be generated using different levels of input in order to determine critical measurements for reliable output from the OBODM.

Online measurements will be used for all measurement in this study. GPS position, velocity, aerostat orientation, aerostat based wind velocities, and 10 m wind velocities will be acquired at a rate of at least 10 Hz. CO_2 measurements are limited to 1 s intervals as determined by the manufacturer's control software. Solar radiance and relative humidity will be logged at least hourly.

3.3 Process measurements

3.3.1 GPS position, velocity, and orientation

The aerostat's GPS position, elevation, acceleration, rotational velocity, linear velocity, and orientation data will be logged serially at 10 Hz using the onboard PC and the Xsens MTiG®. The MTi-G is a GPS-enabled attitude heading and reference system integrated with an inertial measurement unit. MTi-G data will be used to determine the GPS coordinates of the downwind sampler to within 5 cm. These data will be used to determine the flyer's x,y,z distance downwind of the source. Additionally motion data such as velocities and orientation data will be used to correct lofted sonic anemometer data for aerostat motion.

3.3.2 10 m Wind Velocity data

10 m wind velocity data will be acquired using an R.M. Young 8100 3D sonic anemometer mounted to a 10 m mast. This anemometer measures 3D wind velocity and speed of sound based on the transit time of ultrasonic acoustic signals. Data will be logged serially using a laptop PC.

3.3.3 Motion corrected Aerostat based Wind Velocity data

An R.M. Young 81000 3D sonic anemometer will also be affixed to the Flyer instrument pack. The anemometer will be equipped with an integrated GPS and Inertial Measurement Unit (IMU) with a Navigation and Attitude and Heading Reference System (AHRS) pro-

cessor, which measures 3D orientation data, velocity, and rotation data. These data can be used to correct the sonic anemometer for aerostat motion. This procedure has been discussed in detail in the QAPP titled *Aerostat based measurements of biomass burning* (ca. January, 2011).

Aerostat based wind data will be used to acquire wind velocity-height profiles. The wind velocity- height data will be fit using a power law eqn (OBODM manual v. 2, see Eqn. 7-5)

3.3.4 Total Solar Radiance Measurements

The LI-200 Pyranometer is designed for field measurement of global solar radiation in agricultural, meteorological, and solar energy studies. The LI-200 features a silicon photovoltaic detector mounted in a fully cosine-corrected miniature head. Current output, which is directly proportional to solar radiation, is calibrated at the factory against an Eppley Precision Spectral Pyranometer (PSP) under natural daylight conditions in units of watts per square meter ($W \cdot m^{-2}$). Under most conditions of natural daylight, the error is <5% (2).

3.3.5 CO_2 Concentration Measurements

CO_2 is continuously measured in accordance with EPA Method 3A using non-dispersive infrared (NDIR) instrument (LI-820 model, LI-COR Biosciences, USA). This unit is configured with an optional 14 cm optical bench, giving it an analytical range of 0-20,000 ppm with an accuracy specification of less than 2.5% of reading. The LI-820 calibration range is set to 0- 4,500 ppm. A particulate filter precedes the optical lens. The LI-820 voltage equivalent CO_2 concentration will be recorded on the onboard PC . The LI-820 and the DAS will be calibrated for CO_2 on a daily basis according to U.S. EPA Method 3A (2008).

3.3.6 Relative humidity

Relative humidity will be monitored continuously using an on-board HOBO® U12-013 (Onset Computer Corporation, USA) which measures and records relative humidity in %RH at a sampling rate of 1 Hz. The HOBO® U12-013is capable of measuring from 5-95% RH with an accuracy of ± 2.5%RH between 10 and 90%RH but does not exceed ± 3.5%RH. RH data are recorded with a resolution of 0.03% RH. The MTi-G AHRS sensor measures atmospheric pressure in order to determine altitude.

3.3.7 Plume height and diameter

Plume height at apogee will be determined photographically. A series of photos (~2/sec) taken orthogonally to the wind will follow the plume evolution. The GPS height of the aerostat plus its diameter will be used to estimate plume turnover height. Plume diameter will be estimated likewise by a series of photographs taken upwind of the source and coordinated with the other camera. Both cameras will be initiated upon first observation of the plume. Plume diameter will be estimated by use of the aerostat diameter. At the time of this writing, the specific time upon which plume height and diameter should be recorded for use in AERMOD was being solicited by an experienced AERMOD modeler.

4. Sampling Procedure

4.1 Site-Specific Considerations

Nearby structures can interfere with wind and solar radiance measurements, so the placement of the 10 m sonic anemometer and solar radiance meter is important to the data quality of these measurements, so they should be away from wind obstructions and shaded locations, respectively. All other measurements will be located onboard the aerostat. The 10 m sonic will be placed on a 10 m mast at a distance of at least ten times the height of any potentially interfering structures from the structures.(2) Placement of the solar radiation sensor will be such that no shadows will be cast upon the sensor during measurement.

4.2 Labeling Procedures

All data will be logged electronically using either a control pc or an offline data logger. Filenames will include the project name, date, time, and measurement name. i.e.

OBODM-YYMMDDHHmm-MEAS.dat

Where YY, MM, DD, HH, and mm correspond to the year, month, day, hour, and minute that the measurements are acquired. MEAS will correspond to a code indicating the measurement. A key is listed in table 4-1 for these measurement codes.

Table 4- 1 Measurement codes for file naming.

MEAS Code	Measurement
10W	10 m sonic Anemometer
AERW	Aerostat based sonic anemometer
SOLR	Solar Radiance Measurement
CO2	CO2 concentration
GPS	GPS, position, velocity, orientation, data

4.3 Data archiving

Files will be saved in a folder corresponding to the date the data were acquired. Data will be backed up to an external hard drive while in the field and, upon return to the EPA, backed up to a network drive.

5. Measurement Procedures

5.1 Time synchronization

Integrated clocks on data loggers and PC's will be synchronized daily. If time differences greater than 5 seconds are observed from day to day, synchronization frequency will be increased.

5.2 Calibration

5.2.1 MTi-G

The MTiG orientation sensors must be calibrated at least once at the beginning of the test period to ensure accurate magnetic field measurements. Additional calibrations will be conducted if the configuration of the aerostat based sampling pack significantly changes.

5.2.2 Sonic Anemometers

The R.M. Young 8100 3D sonic anemometers are calibrated in the factory annually. Daily calibrations are checked by performing a zero chamber test which is performed to ensure proper function of the sonic anemometer. The zero chamber test consists of placing a bag over the anemometer and recording data for at least 1 minute to ensure that the instrument is properly zeroed.

5.2.3 Total Solar Radiance

The Recalibration of LI-COR radiation sensors is recommended every two years. Sensors must be returned to LI-COR for recalibration. Current output, which is directly proportional to solar radiation, is calibrated at the factory against an Eppley Precision Spectral Pyranometer (PSP) under natural daylight conditions in units of watts per square meter (W m-2). Field calibration checks will consist of a daily zero check by blocking light to the sensor to ensure a zero current/voltage measurement.

5.2.4 CO_2 Concentration Measurements

CO_2 monitors will be calibrated using the EPA approved method. The number of calibration points varies from three to four (i.e., zero gas and either two or three target gas concentrations, range, etc.). Initial instrument ranges will be selected based on previous results in the literature and, thereafter on previous project results.

5.2.5 Plume Photography

Plume characteristics will be recorded photographically using a Nikon D5100 digital SLR camera. The Nikon D5100 has a 16.2 megapixel resolution. The scale is estimated by the known height and dimensions of the balloon which will be a similar distance away from the camera as the plume.

6. QA/QC

6.1 QC Checks and MQOs

QA/QC checks and acceptance criteria for measurements which are considered measurement quality objectives (MQOs) are summarized in Table 6-1 below.

Table 6- 1 QA/QC Checks

Measured Parameter/Method	QA/QC Check Procedure	Reference Standard(s)	QA/QC Check Frequency	Acceptance Criteria/ MQOs	Corrective Action
CO_2 CEM/ EPA Method 3A (NDIR)	2 point zero & calibration drift test	Certified CO_2 calibration gases	1 per sample	±5% of span	Re-calibrate monitor
Sonic Anemometer	Zero Chamber test		Daily	±0.05 m/s	Send to manufacturer for calibration check.
Total Solar Radiance	Zero test		Daily	±20 W/m^2	Send to manufacturer for calibration check

6.2 DQI Goals for Critical Measurements

Data quality indicator (DQI) goals for real time critical measurements are shown in Table 6-2 in terms of accuracy, precision and completeness. Accuracy for the CO_2 monitor will be determined by relative agreement with known concentrations of standard CO_2/N_2 gas mixtures during daily calibrations. Wind velocity and solar radiance accuracy values will be checked by performing daily zero tests. Wind direction accuracy will be determined during measurement using the azimuth from the tether point to the balloon. This azimuth can be determined by the real time gps coordinates of the balloon and the gps location of the tether point and indicates the wind direction. The percentages for wind and solar radiance sensors are determined relative to the full range of the sensor (40 m/s and 3000 W/m^2). Altitude data will be checked at the previously measured ground altitude of 1510 m. For all measurements in table 6-2, precision will be determined by the standard deviation of the time series data.Real time GPS data will be verified using Google Earth Pro and Google maps. Because the standard deviation of the wind velocity is related to turbulence, precision will be determined using the standard deviation of the zero test data. Completeness is determined by comparing the number of measurements that meet DQI goals compared to the total number of measurements taken.

Table 6- 2 Data Quality Indicators

Measurement Parameter	Analysis Method	Accuracy	Precision	Completeness
Wind Velocity	Zero Test	95%	95%	NA
Wind Direction	GPS determined balloon tether azimuth	±20°	±20°	80%
Altitude	Mircobarometer/GPS	10 m	10 m	NA
Carbon dioxide	NDIR CEM	95%	10 ppm	NA
Solar Radiance	Solar Cell	95%	90%	NA
Position	GPS	10 m	10 m	NA

7. Data Analysis

Data will be summarized and analyzed to facilitate the comparison between experimentally determined plume data (height, diameter, concentrations) and values predicted by OBODM. Values required for input into OBODM (*i.e.* Pasquill stability class and mixing layer thickness) will be calculated from experimentally determined data. The calculations necessary to determine the input are discussed in this section as well as experimental output.

7.1 Pasquill's Stability Classes

The Pasquill stability class value is an input for OBODM. The class is determined from the total solar radiation value and wind speed. OBODM guidance(1) relies upon visually determined estimates of the solar radiation to determine the Pasquill stability class. More recent publications use experimentally determined total solar radiation.(2) In this study, the solar radiation will be measured in order to determine the stability class.

Table 7- 1 Table used for determining Pasquill Stability classes*

		Solar Radiation (W/m^2)			
		≥925	925-675	675-175	<175
Wind speed (m/s)	<2	A	A	B	D
	2-3	A	B	C	D
	3-5	B	B	C	D
	5-6	C	C	D	D
	≥6	C	D	D	D

*from EPA-454/R-99-005

7.2 Mixing Layer depth

The mixing layer depth is determined from the net radiation index and wind speed (see table 7-2). The net radiation index is determined from the Pasquill stability class and wind speed (see table 7-3). Tables 7-2 and 7-3 were acquired from the OBODM guidance (1).

Table 7- 2 Table used for Mixing Layer Depth

		Net Radiation Index				
		4	3	2	1	0
Wind speed (m/s)	0-1	2500	2000	1000	500	100
	>1-3	2200	1800	1200	600	200
	>3-5	1800	1500	1200	600	300
	>5-7	1500	1200	1000	600	300
	>7	1200	1000	700	500	300

The net radiation index is a quantized parameter that is indicative of the solar radiation. OBODM uses this value to determine the mixing layer depth (7-2). The net radiation index is determined from the Pasquill stability class and the 10 m winds peed. (1) It is not-

ed that it should be possible to determine the net radiation index directly from the solar radiation but no published relationship could be found.

Table 7- 3 Table used for Net Radiation index

Pasquill Class	10 m windspeed 0-1	>1-3	>3-5	>5-6	>6-7	>7-9	>9-10	>10-11	>11
A	4	4	4	4	4	4	4	4	4
B	2	3	3	3	3	4	4	4	4
C	1	1	2	2	2	3	4	4	4
D	0	0	1	1	0	0	0	0	0

7.3 Turbulent Intensity

Turbulent intensity(3) is determined from high frequency 10 m wind data. The turbulent intensity is defined in Eqn. 7-1.

$$I \equiv \frac{u'}{U} \tag{7-1}$$

Where I is the turbulent intensity, *u'* is the root mean square of the turbulent velocity fluctuations and U is the Reynolds averaged mean velocity. That is,

$$u' \equiv \sqrt{\frac{1}{3}\left(u_x'^2 + u_y'^2 + u_z'^2\right)} \tag{7-2}$$

Where u' indicates the fluctuation of the ith component (x, y, z or u, v, w)
And,

$$U \equiv \sqrt{U_x^2 + U_y^2 + U_z^2} \tag{7-3}$$

Note: A Reynolds averaged time series refers to averages over discrete time steps (as opposed to a continuous running average) in this case.

7.4 Wind speed Profile

OBODM assumes that the height variation of wind speed within the surface mixing layer can be described by the power-law profile:

$$u(z) = u(z_R)\left(\frac{z}{z_R}\right)^p \tag{7-4}$$

where
$u(z)$ = wind speed at height z above the surface
$u(z_R)$ = wind speed at height z_R above the surface
p = wind-profile exponent

7.5 Comparison with output data

Plume concentration, plume height, and plume diameter are calculated and reported by OBODM. Plume height and diameter are used as inputs into AERMOD during risk assessment. The relative agreement (RA) between the OBODM values and experimentally determined values will be determined using Eqn 7-5.

$$RA = 100\% \times \left(1 - \left|\frac{X_{OBODM} - X_{experimental}}{X_{experimental}}\right|\right) \tag{7-5}$$

Where X corresponds to the value being compared (*e.g.* plume height) output by the model and the subscript refers to the theoretical (OBODM) or experimental value.

The modified version of the OBODM allows for the calculation of time series concentration data at a fixed location downwind (see Figure 7-1.) This allows for direct comparison of the OBODM output with the aerostat based background subtracted CO_2 concentration data. Data will be compared based on total exposure (*i.e.* integrated peak areas) and peak concentration. Relative agreement between the model prediction and measurements will be determined for the time series values for each of the approximately 36 plumes to be measured. Data will be compared based on plotting predicted vs observed concentrations at equivalent times for each run and by comparing predicted vs observed plume height and diameter.

Further modeling using AERMOD is necessary to determine the minimum acceptable performance of OBODM and is beyond the scope of this study.

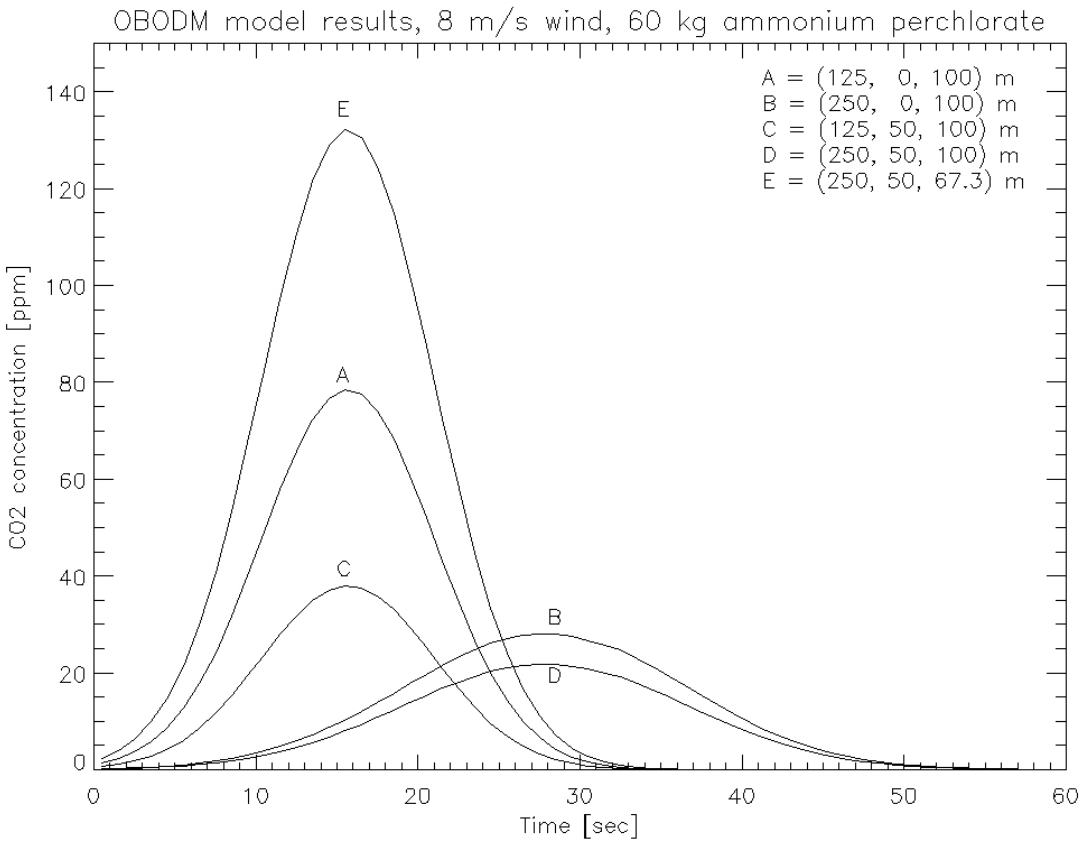


Figure 7- 1 Concentration-Time traces generated by OBODM at different positions downwind of source.

8. References

(1) Open Burn/Open Detonation Dispersion Model User's guide, volumes 1 and 2, DPG Document No. DPG-TR-96-008a February 1998.

(2) Meteorological Monitoring Guidance for Regulatory Modeling applications, EPA-454/R-99-005.

(3) http://www.cfd-online.com/Wiki/Turbulence_intensity

Appendix F: Data for each sample collected.

All emission factors are ambient air background corrected. The XRF metal uncertainty measurement represents the statistical range in which a measurement may fall. Value less than three times the uncertainty is below 99.7% confidence.

Table F1. Number of samples collected for each munitions type.

Munitions type	Buried depth	Energetics	PM2.5	PM10	Total PM	Total PM[a]	VOC	HCl/perchlorate/chlorate
Comp B	Surface	1	2	2	4	1	0	0
Comp B	3 feet	4	4	4	8	4	1	0
Comp B	6 feet	2	2	2	4	2	0	0
V453	3 feet	1	3	3	6	1	0	0
V453	6 feet	3	3	3	6	3	0	0
V548	3 feet	3	2	2	4	2	1	0
V548[b]	3 feet	2	6	6	12	2	2	0
ARC 451	DNA	0	1	1	2	DNA	1	3[c]
ARC452 A	DNA	0	0	1	1	DNA	1	2[c]

* DNA – Does not apply. [a] Total PM from Energetics filter. [b] Ground sampling. [c] No results due to malfunction of the pumps.

Table F2. Energetic emission factor in lb/lb Carbon for each collected air sample.*

	Comp B Surface	Comp B 3 feet	Comp B 3 feet	Comp B 3 feet	Comp B 3 feet	Comp B 6 feet	Comp B 6 feet	V453 3 feet	V453 6 feet	V453 6 feet	V453 6 feet	V548 3 feet	V548# 3 feet	V548# 3 feet
HMX	5.0E-07	5.5E-07	ND	1.3E-06	5.9E-06	3.0E-06	7.8E-07	5.8E-06	ND	4.7E-06	ND	1.8E-04	1.1E-04	5.3E-04
RDX	2.6E-06	1.7E-06	ND	1.6E-06	2.0E-05	7.4E-06	1.8E-06	5.6E-06	ND	5.2E-06	ND	ND	1.1E-06	ND
1,3,5-Trinitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trinitrotoluene (TNT)	2.6E-06	3.2E-07	ND	ND	1.6E-05	3.0E-06	3.3E-07	ND	ND	ND	ND	ND	ND	ND
4-Amino-2,6-dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Amino-4,6-dinitrotoluene	1.0E-07	3.0E-07	3.2E-07	3.3E-07	1.7E-06	5.7E-07	4.8E-07	3.0E-06	ND	2.3E-06	2.0E-06	1.3E-06	ND	ND
2,4-Dinitrotoluene	1.0E-06	1.1E-05	6.3E-06	1.5E-05	ND	8.2E-06	9.6E-06	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,5-Dinitroaniline	ND	ND	ND	ND	ND	ND	ND	2.4E-06	ND	ND	2.5E-06	ND	ND	ND
Pentaerythritol Tetranitrate	2.6E-07	5.3E-07	5.7E-07	ND	ND	ND	ND	5.8E-06	ND	ND	ND	ND	4.7E-06	ND

* ND – not detected. # Ground based sampling.

Table F3. Energetic concentrations in ng/m^3 and amount of carbon for each collected air sample.*

	Comp B Surface	Comp B 3 feet	Comp B 3 feet	Comp B 3 feet	Comp B 3 feet	Comp B 6 feet	Comp B 6 feet	V453 3 feet	V453 6 feet	V453 6 feet	V453 6 feet	V548 3 feet	V548# 3 feet	V548# 3 feet	Ambient	Ambient
HMX	7.7 [3.1]	17 [16]	ND [25]	46 [26]	71 [56]	32 [11]	32 [31]	13 [11]	ND [44]	32 [26]	ND [38]	1828 [27]	1572 [20]	3485 [40]	0.14 [0.10]	0.14 [0.10]
RDX	41 [2.2]	54 [11]	ND [18]	57 [19]	245 [40]	77 [7.7]	75 [22]	13 [7.7]	ND [34]	35 [19]	ND [27]	ND [19]	15 [14]	ND [29]	0.14 [0.070]	ND [0.071]
1,3,5-Trinitrobenzene	ND [3.5]	ND [18]	ND [28]	ND [29]	ND [62]	ND [12]	ND [34]	ND [12]	ND [25]	ND [29]	ND [42]	ND [30]	ND [22]	ND [44]	ND [0.11]	ND [0.11]]
1,3-Dinitrobenzene	ND [7.7]	ND [39]	ND [62]	ND [64]	ND [138]	ND [26]	ND [76]	ND [27]	ND [38]	ND [64]	ND [94]	ND [67]	ND [49]	ND [98]	ND [0.24]	ND [0.24]
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	ND [2.2]	ND [11]	ND [18]	ND [19]	ND [40]	ND [7.7]	ND [22]	ND [7.7]	ND [85]	ND [19]	ND [27]	ND [19]	ND [14]	ND [29]	ND [0.070]	ND [0.071]
2,4,6-Trinitrotoluene (TNT)	41 [1.4]	10 [6.9]	ND [11]	ND [11]	198 [24]	32 [4.7]	13 [13]	ND [4.7]	ND [25]	ND [11]	ND [17]	ND [12]	ND [8.6]	ND [17]	0.23 [0.043]	ND [0.043]
4-Amino-2,6-dinitrotoluene	ND [2.0]	ND [10]	ND [16]	ND [16]	ND [36]	ND [6.8]	ND [20]	ND [6.9]	ND [15]	ND [16]	ND [24]	ND [17]	ND [13]	ND [25]	ND [0.062]	ND [0.063]
2-Amino-4,6-dinitrotoluene	1.6 [1.1]	9.4 [5.6]	15 [8.9]	11 [9.3]	20 [20]	6.0 [3.8]	20 [11]	6.9 [3.9]	ND [22]	15 [9.3]	15 [14]	13 [10]	ND [7.1]	ND [14]	ND [0.035]	0.043 [0.035]
2,4-Dinitrotoluene	16 [15]	351 [75]	298 [119]	504 [124]	ND [267]	85 [51]	392 [147]	ND [52]	ND [12]	ND [123]	ND [181]	ND [129]	ND [94]	ND [190]	2.1 [0.47]	ND [0.47]
2,6-Dinitrotoluene	ND [8.5]	ND [43]	ND [69]	ND [71]	ND [153]	ND [29]	ND [85]	ND [30]	ND [164]	ND [71]	ND [104]	ND [74]	ND [54]	ND [109]	ND [0.27]	ND [0.27]
3,5-Dinitroaniline	ND [1.5]	ND [7.5]	ND [12]	ND [12]	ND [27]	ND [5.1]	ND [15]	5.6 [5.2]	ND [95]	ND [12]	20 [18]	ND [13]	ND [9.4]	ND [19]	ND [0.047]	ND [0.047]
Pentaerythritol Tetranitrate	4.1 [2.5]	16 [13]	27 [20]	ND [21]	ND [44]	ND [8.5]	ND [25]	13 [8.6]	ND [27]	ND [21]	ND [30]	ND [22]	67 [16]	ND [32]	ND [0.078]	ND [0.078]
Carbon (mg/m^3)	15	31	47	34	12	10	41	7.2	3.4	6.8	7.8	10	14	6.5	NA	NA

* ND=Not detected, detection limit within parentheses. # Ground based sampling.

Table F4. PM energetic concentration in µg/kg.*

		Comp B			V453		V548
		Surface	**3 feet**	**6 feet**	**3 feet**	**6 feet**	**3 feet**
HMX	**Average**	113	18	18	11	38	1253
	N	1	3	2	1	1	3
	STDV	DNA	12	DNA	DNA	DNA	266
	AD/2		DNA	5.6	DNA	DNA	DNA
RDX	**Average**	600	47	44	10	42	10
	N	DNA	3	2	1	1	1
	STDV	DNA	46	DNA	DNA	DNA	DNA
	AD/2	DNA	DNA	14	DNA	DNA	DNA
TNT	**Average**	600	42	15	DNA	DNA	DNA
	N	DNA	2	2	DNA	DNA	DNA
	STDV	DNA	DNA	DNA	DNA	DNA	DNA
	AD/2	DNA	39	9.3	DNA	DNA	DNA

* DNA – Does not apply. AD- absolute difference. N – number of samples. STDV – standard deviation.

Table F5. Energetic concentrations in µg/kg for each collected soil sample.*

	Pit Back-ground	Post detonation of Comp B	Sand fill, background	Post detonation of V453	Post detonation of V548
HMX	ND [2.5]	ND [2.5]	ND [2.5]	ND [2.5]	7.0 [2.5]
RDX	ND [1.8]	ND [1.8]	ND [1.8]	2.2 [1.8]	2.9 [1.8]
1,3,5-Trinitrobenzene	ND [2.8]	ND [2.8]	ND [2.8]	ND [2.8]	ND [2.8]
1,3-Dinitrobenzene	ND [6.2]	ND [6.2]	ND [6.2]	ND [6.2]	ND [6.2]
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	ND [1.8]	ND [1.8]	ND [1.8]	ND [1.8]	ND [1.8]
2,4,6-Trinitrotoluene (TNT)	11 [1.1]	5.8 [1.1]	ND [1.1]	2.6 [1.1]	ND [1.1]
4-Amino-2,6-dinitrotoluene	ND [1.6]	ND [1.6]	ND [1.6]	ND [1.6]	ND [1.6]
2-Amino-4,6-dinitrotoluene	ND [0.90]	ND [0.90]	ND [0.90]	ND [0.90]	ND [0.90]
2,4-Dinitrotoluene	ND [12]	ND [12]	ND [12]	ND [12]	ND [12]
2,6-Dinitrotoluene	ND [6.9]	ND [6.9]	ND [6.9]	ND [6.9]	ND [6.9]
3,5-Dinitroaniline	ND [1.2]	ND [1.2]	ND [1.2]	ND [1.2]	ND [1.2]
Pentaerythritol Tetranitrate	4.2 [2.0]	ND [2.0]	ND [2.0]	ND [2.0]	ND [2.0]

* One soil sample for each matrix. ND – not detectable. Detection levels within brackets.

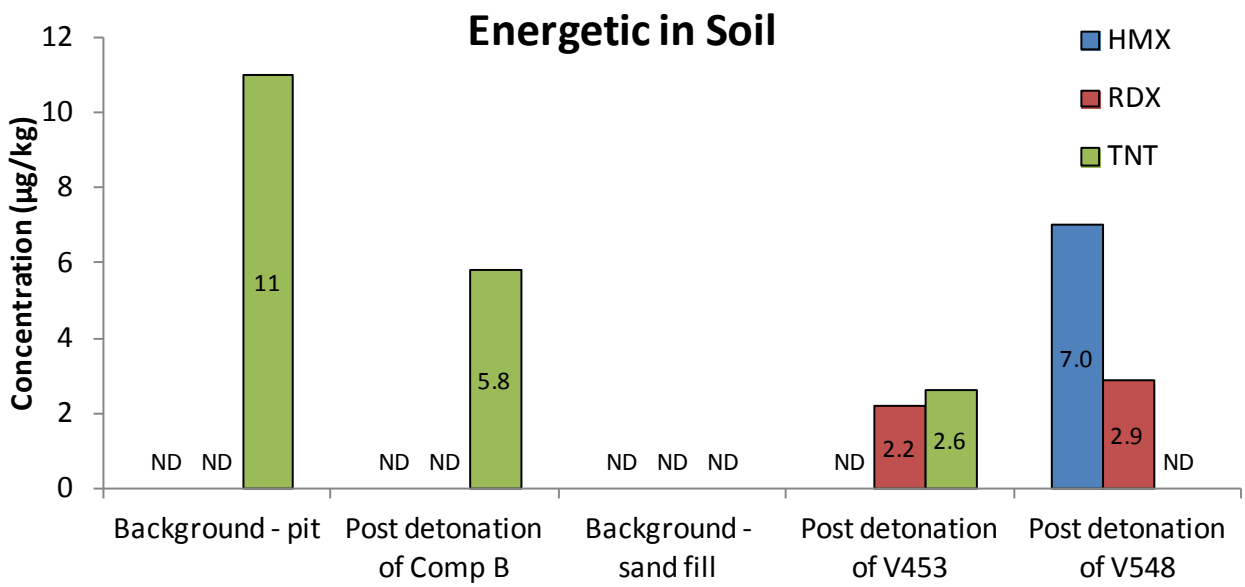


Figure F-1. HMX, RDX, and TNT concentration in the soil, both pre- and post-detonation.

Table F6. PM EF for each collected sample, in lb/lb NEW.*

Munitions			Total PM From Energetic filter lb/lb NEW	Total PM From PM10 impactor lb/lb NEW	Total PM From PM2.5 impactor lb/lb NEW	PM10 lb/lb NEW	PM2.5 lb/lb NEW
1	CompB	Surface	1.1	0.19	0.48	0.16	0.34
2	CompB	Surface	NS	0.67	0.73	0.43	0.51
1	CompB	3 feet	26	49	19	41	5.1
2	CompB	3 feet	22	164	9.3	51	3.9
3	CompB	3 feet	17	59	7.6	155	4.0
4	CompB	3 feet	51	970	22	968	17
1	CompB	6 feet	32	16	25	9.1	13
2	CompB	6 feet	15	86	41	6.9	6.4
1	V453	3 feet	126	269	12	258	7.7
2	V453	3 feet	NS	65	21	52	9.2
3	V453	3 feet	NS	438	14	404	9.4
1	V453	6 feet	48	63	24	20	17
2	V453	6 feet	29	1332	18	1300	12
3	V453	6 feet	21	31	145	14	8.4
1	V548	3 feet	36	241	6.3	209	3.6
2	V548	3 feet	79	164	48	74	17
1	V548	3 feet, ground[a]	35	516	105	431	18
2	V548	3 feet, ground[a]	56	308	164	50	11
3	V548	3 feet, ground[a]	NS	102	45	26	11
4	V548	3 feet, ground[a]	NS	673	87	278	19
5	V548	3 feet, ground[a]	NS	308	20	639	14
6	V548	3 feet, ground[a]	NS	356	8.2	268	6.7
1	ARC452A	DNA	NS	15	NS	0.31	NS
1	ARC451	DNA	NS	7.6	0.30	0.28	0.25

*NS – Not Sampled. DNA – Does not apply. [a] Sampling performed at ground levels.

Table F7. PM concentration and amount carbon collected in each sample.*

	Sample #	PM2.5	Total PM	Carbon	Sample #	PM10	Total PM	Carbon
		mg/m^3	mg/m^3	mg/m^3		mg/m^3	mg/m^3	mg/m^3
Comp B Surface	1	73	106	55	1	35	42	55
	2	48	68	23	2	40	63	23
Comp B 3 feet	1	662	2472	32	1	5327	6297	32
	2	713	1686	45	2	9250	10691	45
	3	542	1031	34	3	20981	22318	34
	4	568	741	8.6	4	33362	33434	8.6
Comp B 6 feet	1	1765	3410	34	1	1244	2135	34
	2	1112	7135	43	2	1183	14831	43
V453 3 feet	1	403	601	12	1	13551	14096	12
	2	192	435	4.9	2	1075	1340	4.9
	3	371	555	9.3	3	15956	17308	9.3
V453 6 feet	1	210	299	2.9	1	251	788	2.9
	2	306	441	5.8	2	32319	33096	5.8
	3	153	265	4.3	3	255	564	4.3
V548 3 feet	1	138	239	8.6	1	7897	9110	8.6
	2	445	1285	6.1	2	1978	4373	6.1
V5483 feet, ground	1	1223	7228	16	1	29738	35586	16
	2	1032	14951	21	2	4575	28141	21
	3	806	3370	17	3	1958	7643	17
	4	1543	6983	18	4	22396	54213	18
	5	623	890	10	5	29024	29626	10
	6	303	371	10	6	12102	16094	10
ARC 452A	NS	NS	NS	NS	1	82	3968	41
ARC 451	1	71	84	44	1	85	2323	48
Ambient	1	0.0054	0.0068	DNA	1	0.58	0.59	DNA

* NS – Not Sampled. DNA – Does not apply.

Table F8. Metals in each collected PM10 sample in µg/sample, and mass, carbon sampled and sampled volume for each sample.[1]

Sample #	Matrix	Buried depth	Mass g/sample	Carbon sampled mg/m^3	Sampling Volume m^3	Na	Mg	Al	K	Ca	Mn	Fe	Hf	Pb	Zr
1A	Comp B	Surface	5.90E-04	55	1.65E-02	9.0	5.8	11	4.5	11	0.080	4.8	0.055*	0.029*	0.036*
						[1.3]	[0.60]	[0.77]	[0.24]	[0.58]	[0.014]	[0.25]	[0.044]	[0.022]	[0.014]
1B	Comp B	Surface	6.79E-04	23	1.67E-02	8.1	5.2	12	4.6	8.4	0.13	6.0	0.0011*	0.027*	0.037*
						[1.2]	[0.56]	[0.85]	[0.24]	[0.43]	[0.015]	[0.031]	[0.044]	[0.026]	[0.014]
2A	Comp B	3 feet	8.74E-03	32	1.63E-02	ND	23*	175	80	123	1.6	83	ND	0.11	0.55
						[74]	[16]	[25]	[4.5]	[6.7]	[0.086]	[4.1]	[0.043]	[0.023]	[0.033]
2B	Comp B	3 feet	5.86E-03	34	9.83E-03	ND	7.5*	59	22	42	0.32	18	0.034*	0.0079*	0.16
						[17]	[4.1]	[6.3]	[1.2]	[2.2]	[0.024]	[0.93]	[0.027]	[0.015]	[0.014]
2C	Comp B	3 feet	1.05E-02	45	1.18E-02	ND	10*	185	97	178	1.6	92	ND	0.14	0.80
						[25]	[9.9]	[29]	[5.6]	[9.8]	[0.089]	[4.6]	[0.049]	[0.026]	[0.045]
2D	Comp B	3 feet	2.74E-03	8.6	6.17E-03	ND	5.5	39	15	24	0.31	14	0.015*	0.062	0.11
						[4.7]	[1.7]	[3.3]	[0.79]	[1.3]	[0.023]	[0.73]	[0.025]	[0.015]	[0.012]
3A	Comp B	6 feet	3.76E-03	34	3.00E-03	10.5	6.6	11	4.0	6.3	0.089	4.2	ND	0.032*	0.012*
						[2.5]	[0.94]	[0.95]	[0.22]	[0.33]	[0.012]	[0.21]	[0.041]	[0.020]	[0.012]
3B	Comp B	6 feet	9.28E-03	43	7.83E-03	ND	13*	156	57	92	0.89	54	ND	0.095	0.43
						[15]	[8.0]	[19]	[4.5]	[5.0]	[0.052]	[2.7]	[0.053]	[0.027]	[0.027]
4A	V 453	3 feet	3.44E-03	4.9	2.37E-02	ND	4.9*	39	13	21	0.28	16	0.017*	0.0068*	0.090
						[5.7]	[1.7]	[3.5]	[0.68]	[1.1]	[0.022]	[0.78]	[0.026]	[0.015]	[0.012]
4B	V 453	3 feet	4.14E-03	12	1.67E-02	ND	9.3*	92	35	48	0.73	40	ND	0.042	0.30
						[17]	[4.4]	[9.1]	[1.9]	[2.5]	[0.043]	[2.0]	[0.032]	[0.017]	[0.020]
4C	V 453	3 feet	1.96E-03	9.3	9.17E-03	ND	2.8	30	12	18	0.24	13	ND	0.019*	0.085
						[2.9]	[0.91]	[2.3]	[0.61]	[0.93]	[0.019]	[0.65]	[0.025]	[0.014]	[0.011]
5A	V 453	6 feet	2.08E-03	2.9	8.17E-03	ND	3.2	34	11	17	0.21	14	0.020*	0.018*	0.062
						[0.89]	[0.82]	[2.5]	[0.83]	[1.3]	[0.018]	[0.71]	[0.044]	[0.023]	[0.014]
5B	V 453	6 feet	2.33E-03	5.8	1.07E-02	7.8*	4.6	44	17	26	0.35	20	ND	0.063	0.12
						[4.8]	[1.4]	[3.6]	[0.88]	[1.3]	[0.025]	[0.99]	[0.028]	[0.016]	[0.014]
5C	V 453	6 feet	1.57E-03	4.3	6.00E-03	ND	2.3	21	9.1	12	0.17	11	0.12*	ND	0.036*
						[0.69]	[0.65]	[1.5]	[0.47]	[0.61]	[0.017]	[0.58]	[0.044]	[0.022]	[0.014]
6A	V 548	3 feet	4.02E-03	8.6	1.00E-02	ND	4.7*	52	19	33	0.51	25	0.0023*	0.15	0.079
						[8.7]	[2.2]	[4.8]	[1.0]	[2.5]	[0.033]	[1.3]	[0.029]	[0.018]	[0.012]
6B	V 548	3 feet	9.51E-03	16	1.57E-02	37*	24*	127	51	92	1.2	61	ND	0.21	0.37
						[51]	[11]	[17]	[2.8]	[5.0]	[0.068]	[3.2]	[0.034]	[0.022]	[0.023]
6C	V 548	3 feet	2.84E-03	6.1	6.50E-03	0.70*	6.3	45	17	27	0.52	24	ND	0.13	0.11
						[4.87]	[1.8]	[3.8]	[0.91]	[1.4]	[0.033]	[1.2]	[0.031]	[0.018]	[0.014]
7A	V 548	3 feet	1.05E-02	21	1.02E-02	ND	33*	235	102	191	2.2	117	ND	0.35	0.68
						[100]	[23]	[36]	[5.7]	[11]	[0.12]	[8.3]	[0.053]	[0.033]	[0.040]
7B	V 548	3 feet	9.54E-03	17	8.83E-03	ND	43*	268	119	219	3.0	134	ND	0.42	0.78
						[95]	[27]	[40]	[6.7]	[12]	[0.16]	[6.7]	[0.053]	[0.035]	[0.044]
7C	V 548	3 feet	1.60E-03	10	6.33E-03	4.2*	2.5	22	8.5	15	0.22	9.6	ND	0.057	0.027*
						[2.3]	[0.73]	[1.7]	[0.45]	[0.78]	[0.018]	[0.49]	[0.026]	[0.015]	[0.011]
7D	V 548	3 feet	7.86E-03	18	3.83E-03	20*	27*	143	49	88	1.1	52	ND	0.15	0.28

Sample #	Matrix	Buried depth	Mass g/sample	Carbon sampled mg/m³	Sampling Volume m³	Na	Mg	Al	K	Ca	Mn	Fe	Hf	Pb	Zr
						[31]	[9.6]	[18]	[2.6]	[4.7]	[0.063]	[2.6]	[0.031]	[0.018]	[0.018]
7E	V 548	3 feet	3.16E-03	10	5.17E-03	5.9* [5.8]	10 [2.4]	59 [5.1]	25 [1.3]	45 [2.3]	0.62 [0.037]	28 [1.4]	ND [0.027]	0.059 [0.015]	0.14 [0.014]
8A	Ambient	DNA	1.97E-04	DNA	2.37E+00	ND [0.34]	0.39* [0.26]	3.9 [0.32]	1.5 [0.088]	2.2 [0.12]	0.050 [0.010]	1.8 [0.098]	0.036* [0.027]	0.043* [0.015]	0.024* [0.011]
8B	Ambient	DNA	1.06E-03	DNA	3.30E+02	0.10* [1.5]	4.4 [0.66]	26 [1.9]	10 [0.53]	9.8 [0.50]	0.33 [0.024]	14 [0.71]	0.041* [0.029]	0.037* [0.016]	0.066 [0.012]

1. DNA – Does not apply. ND – not detected. Uncertainty limits within brackets. * Concentrations are three time less than the uncertainty.

Table F9. Metals in each collected PM2.5 sample in µg/sample, and mass, carbon sampled and sampled volume for each sample.[1]

Sample #	Matrix	Buried depth	Mass g/sample	Carbon sampled mg/m³	Sampling Volume m³	Na	Mg	Al	K	Ca	Mn	Fe	Hf	Pb	Zr
1A	Comp B	Surface	1.21E-03	55	1.65E-02	6.3 [1.4]	5.1 [0.63]	11 [0.82]	4.2 [0.34]	12 [0.61]	0.090 [0.014]	4.4 [0.23]	ND [0.043]	0.015 [0.022]	0.035 [0.014]
1B	Comp B	Surface	8.01E-04	23	1.67E-02	4.6 [1.2]	3.9 [0.53]	11 [0.78]	4.3 [0.23]	7.7 [0.40]	0.11 [0.014]	5.1 [0.26]	0.064* [0.043]	ND [0.022]	0.050 [0.014]
2A	Comp B	3 feet	1.06E-02	32	1.63E-02	ND [55]	16* [11]	122 [18]	43 [2.4]	64 [3.5]	0.81 [0.048]	40 [2.0]	0.0056* [0.032]	0.024* [0.017]	0.25 [0.018]
2B	Comp B	3 feet	4.44E-03	34	9.83E-03	ND [12]	6.3* [3.0]	58 [5.7]	23 [1.2]	46 [2.4]	0.39 [0.027]	22 [1.1]	ND [0.029]	0.032 [0.016]	0.18 [0.016]
2C	Comp B	3 feet	7.26E-03	45	1.18E-02	ND [37]	9.1* [7.1]	96 [12]	38 [2.1]	73 [5.6]	0.70 [0.042]	39 [2.0]	ND [0.032]	0.064 [0.017]	0.25 [0.018]
2D	Comp B	3 feet	2.52E-03	8.6	6.17E-03	ND [4.1]	4.3 [1.3]	35 [2.9]	14 [0.73]	23 [1.2]	0.30 [0.023]	14 [0.73]	0.028* [0.028]	0.068 [0.016]	0.089 [0.012]
3A	Comp B	6 feet	5.29E-03	34	3.00E-03	22 [5.3]	14 [1.9]	32 [2.9]	11 [0.58]	16 [0.83]	0.24 [0.019]	11 [0.56]	ND [0.042]	0.019 [0.022]	0.0056* [0.014]
3B	Comp B	6 feet	8.71E-03	43	7.83E-03	ND [17]	21* [9.8]	206 [25]	86 [6.8]	132 [10]	1.4 [0.075]	82 [4.1]	ND [0.064]	0.17 [0.033]	0.65 [0.038]
4A	V 453	3 feet	4.50E-03	4.9	2.37E-02	ND [9.3]	6.5* [2.6]	56 [5.4]	21 [1.1]	34 [1.8]	0.45 [0.029]	24 [1.2]	ND [0.029]	0.066 [0.017]	0.20 [0.017]
4B	V 453	3 feet	7.27E-03	12	1.67E-02	ND [20]	8.8* [4.8]	73 [8.4]	24 [1.3]	34 [1.8]	0.47 [0.031]	27 [1.4]	0.0068* [0.028]	0.054 [0.015]	0.18 [0.015]
4C	V 453	3 feet	2.49E-03	9.3	9.17E-03	ND [2.9]	2.8 [0.88]	25 [2.0]	9.2 [0.48]	15 [0.75]	0.23 [0.018]	11 [0.54]	ND [0.026]	0.0068* [0.014]	0.097 [0.011]
5A	V 453	6 feet	1.71E-03	2.9	8.17E-03	1.1 [1.1]	4.2 [1.0]	30 [2.3]	11 [0.58]	18 [0.94]	0.21 [0.019]	15 [0.73]	0.037* [0.048]	0.0056* [0.024]	0.079 [0.016]
5B	V 453	6 feet	3.20E-03	5.8	1.07E-02	ND [4.5]	3.9* [1.4]	35 [3.0]	13 [0.66]	19 [1.0]	0.26 [0.020]	16 [0.79]	0.043* [0.026]	0.057 [0.015]	0.087 [0.011]

Sample #	Matrix	Buried depth	Mass g/sample	Carbon sampled mg/m^3	Sampling Volume m^3	Na	Mg	Al	K	Ca	Mn	Fe	Hf	Pb	Zr
5C	V 453	6 feet	9.16E-04	4.3	6.00E-03	9.8 [1.4]	5.1 [0.57]	11 [0.83]	4.4 [0.23]	5.9 [0.31]	0.078 [0.012]	5.3 [0.27]	ND [0.044]	0.029* [0.022]	0.044 [0.014]
6A	V 548	3 feet	9.82E-04	8.6	1.00E-02	1.1* [1.1]	1.0 [0.32]	5.6 [0.45]	2.4 [0.13]	3.6 [0.19]	0.049 [0.011]	2.9 [0.15]	0.077 [0.026]	0.033* [0.015]	0.0079* [0.010]
6B	V 548	3 feet	1.63E-02	16	1.57E-02	ND [101]	21* [18]	146 [28]	39 [2.2]	73 [4.0]	0.83 [0.049]	40 [2.0]	ND [0.033]	0.15 [0.019]	0.25 [0.018]
6C	V 548	3 feet	1.95E-03	6.1	6.50E-03	3.5* [2.5]	4.8 [0.97]	31 [2.4]	12 [0.64]	20 [1.0]	0.35 [0.025]	17 [0.86]	ND [0.027]	0.10 [0.016]	0.078 [0.011]
7A	V 548	3 feet	9.15E-03	21	1.02E-02	ND [41]	18* [9.4]	125 [17]	48 [2.6]	90 [4.8]	1.1 [0.061]	57 [4.5]	ND [0.035]	0.17 [0.020]	0.31 [0.020]
7B	V 548	3 feet	4.59E-03	17	8.83E-03	ND [10]	11* [3.7]	78 [7.6]	33 [1.8]	67 [5.0]	0.97 [0.055]	43 [2.1]	ND [0.028]	0.11 [0.017]	0.16 [0.015]
7C	V 548	3 feet	1.74E-03	10	6.33E-03	ND [1.7]	1.4 [0.47]	10 [0.83]	4.4 [0.23]	7.4 [0.38]	0.11 [0.012]	5.0 [0.26]	0.038* [0.026]	0.033* [0.014]	0.024* [0.010]
7D	V 548	3 feet	5.68E-03	18	3.83E-03	ND [19]	14* [5.2]	109 [12]	36 [1.9]	68 [3.6]	1.0 [0.058]	45 [2.2]	ND [0.031]	0.13 [0.018]	0.21 [0.016]
7E	V 548	3 feet	2.52E-03	10	5.17E-03	ND [2.6]	3.7 [0.91]	26 [2.2]	10 [0.54]	18 [0.94]	0.24 [0.019]	12 [0.59]	0.011* [0.057]	0.024* [0.015]	0.076 [0.011]
8A	Ambient	DNA	2.66E-04	DNA	2.37E+00	ND [0.89]	0.43* [0.25]	2.9 [0.25]	1.2 [0.075]	1.9 [0.10]	0.026* [0.010]	1.6 [0.089]	0.029* [0.026]	0.036* [0.015]	0.029* [0.010]
8B	Ambient	DNA	1.40E-03	DNA	3.30E+02	2.8* [1.7]	5.0 [0.73]	25 [1.8]	10 [0.53]	9.5 [0.49]	0.32 [0.023]	14 [0.70]	0.018* [0.029]	0.034* [0.016]	0.064 [0.012]

1. DNA – Does not apply. ND – not detected. Uncertainty limits within brackets. * Concentrations are three time less than the uncertainty.

Table F10. Metals in each collected Total PM sample in µg/sample, and mass, carbon sampled and sampled volume for each sample.*

Sample #	Matrix	Buried depth	Mass g/sample	Carbon sampled mg/m3	Sampling volume m3	Na	Mg	Al	K	Ca	Mn	Fe	Hf	Pb	Zr
1A	Comp B	Surface	7.00E-04	55	1.65E-02	13	6.7	13	5.8	122	0.20	6.6	0.055	0.029	0.036
1B	Comp B	Surface	1.06E-03	23	1.67E-02	13	6.1	15	6.3	136	0.27	8.2	0.0011	0.52	0.10
2A	Comp B	3 feet	1.03E-01	32	1.63E-02	6.2	35	215	91	249	2.4	126	ND	0.57	0.65
2B	Comp B	3 feet	2.19E-01	34	9.83E-03	7.0	25	112	37	212	1.3	75	0.034	0.44	0.27
2C	Comp B	3 feet	1.27E-01	45	1.18E-02	5.6	26	235	112	346	2.7	144	ND	0.66	0.90
2D	Comp B	3 feet	2.06E-01	8.6	6.17E-03	4.1	7.0	45	17	58	0.44	19	0.015	0.31	0.17
3A	Comp B	6 feet	6.41E-03	34	3.00E-03	14	12	28	9.0	99	0.53	20	ND	0.032	0.012
3B	Comp B	6 feet	1.16E-01	43	7.83E-03	10	116	458	133	648	8.2	460	ND	0.095	0.79
4A	V 453	3 feet	3.17E-02	4.9	2.37E-02	5.9	13	74	23	144	0.91	48	0.017	0.40	0.25
4B	V 453	3 feet	2.35E-01	12	1.67E-02	6.0	21	138	48	252	1.6	82	ND	0.51	0.49
4C	V 453	3 feet	1.59E-01	9.3	9.17E-03	5.7	14	75	25	215	1.1	54	ND	0.50	0.29
5A	V 453	6 feet	6.44E-03	2.9	8.17E-03	4.2	7.5	48	15	194	0.60	30	0.020	0.018	0.062
5B	V 453	6 feet	3.53E-01	5.8	1.07E-02	14	19	97	32	166	1.3	74	ND	0.34	0.31
5C	V 453	6 feet	3.39E-03	4.3	6.00E-03	3.8	3.5	25	11	173	0.33	16	0.12	ND	0.036
6A	V 548	3 feet	9.11E-02	8.6	1.00E-02	5.9	18	101	32	118	1.4	74	0.0023	0.61	0.18
6B	V 548	3 feet	5.58E-01	16	1.57E-02	60	220	707	214	1032	14	680	ND	1.0	0.94
6C	V 548	3 feet	2.84E-02	6.1	6.50E-03	9.4	41	165	50	248	3.0	141	ND	0.63	0.27
7A	V 548	3 feet	2.86E-01	21	1.02E-02	60	565	1865	522	2431	37	1937	ND	1.7	1.9
7B	V 548	3 feet	6.75E-02	17	8.83E-03	10	116	512	184	542	8.5	399	ND	0.97	1.1
7C	V 548	3 feet	1.02E-01	10	6.33E-03	7.7	5.5	32	12	71	0.45	19	ND	0.33	0.027
7D	V 548	3 feet	2.08E-01	18	3.83E-03	39	175	596	181	625	11	529	ND	0.77	0.81
7E	V 548	3 feet	1.53E-01	10	5.17E-03	10	18	87	34	187	1.2	52	ND	0.45	0.19
8A	Ambient	DNA	1.39E-01	DNA	2.37E+00	3.5	1.0	5.6	2.6	108	0.12	3.3	0.036	0.31	0.067

* DNA – Does not apply.

Table F11. Metal concentration from ARC 451 and ARC 452A.

Propellant	PM2.5 (µg/g)		Total PM (µg/g)		PM10 (µg/g)		Total PM (µg/g)	
	Al	Fe	Al	Fe	Al	Fe	Al	Fe
ARC 451	3646 [15]	NA	3671 [15]	NA	48339 [18]	NA	1827 [18]	NA
ARC 452A	NS	NS	NS	NS	60465 [29]	2474 [3.9]	1291 [29]	184 [3.9]

* Only one sample collected from each propellant. Detection limit within brackets.
NS – Not sampled. NA – not analyzed.

Table F12. Metal concentration in each collected soil sample in µg/g.*

	Pit Background	Post detonation of CompB	Sand fill Background	Post detonation of V453	Post detonation of V548
Aluminum	3940 [1.48]	3450 [1.45]	3470 [1.40]	3810 [1.41]	4220 [1.34]
Calcium	7670 [0.494]	7820 [0.483]	5870 [0.466]	6370 [0.469]	5560 [0.447]
Iron	5060 [0.198]	5040 [0.0193]	4980 [0.187]	4860 [0.188]	5070 [0.179]
Hafnium	<MDL [0.198]	<MDL [0.198]	<MDL [0.198]	<MDL [0.198]	<MDL [0.198]
Potassium	1140 [0.494]	1110 [0.483]	922 [0.466]	1120 [0.469]	1230 [0.447]
Magnesium	1710 [0.198]	1680 [0.193]	1220 [0.187]	1400 [0.188]	1550 [0.179]
Manganese	101 [0.020]	90.6 [0.019]	83.9 [0.019]	90.5 [0.019]	103 [0.018]
Sodium	90.4 [1.19]	128 [1.16]	73.6 [1.12]	104 [1.13]	100 [1.07]
Lead	1.06 [0.494]	1.35 [0.483]	1.16 [0.466]	1.35 [0.469]	0.75 [0.447]
Zirconium	3.94 [0.099]	4.56 [0.097]	3.79 [0.093]	8.49 [0.094]	3.18 [0.089]

* MDL – method detection limit. MDL within brackets.

Table F13. Metal analyses comparison: ICP versus XRF, in µg/gram.*

	Filter Sample #	Matrix	Buried depth	Al	Ca	Fe	Hf	K	Mg	Mn	Na	Pb	Zr
ICP	1A	Comp B	Surface	18458	25610	9186	ND [169]	3868	3729	253	4463	ND [423]	ND [85]
XRF	1A	Comp B	Surface	18068	19119	8108	94 [75]	7637	9892	136	15293	50 [36]	61 [23]
ICP	3B	Comp B	6 feet	7526	10410	6022	ND [11]	1913	1729	134	532	ND [27]	12
XRF	3B	Comp B	6 feet	16787	9955	5809	ND [5.7]	6133	1391	96	ND [1594]	10	46
ICP	5C	V 453	6 feet	10483	9612	7730	ND [64]	2266	2090	167	1331	ND [159]	ND [32]
XRF	5C	V 453	6 feet	13083	7552	7260	75 [28]	5787	1479	106	ND [436]	ND [14]	23 [7.2]

* ICP - inductively coupled plasma. XRF - X-ray fluorescence. ND – not detected. Detection limits within brackets.

Table F14. VOC EF for each collected sample in lb/lb Carbon.*

	Sample #	Benzene	Toluene	Ethylbenzene	Xylene	1,2,4-Trimethylbenzene
Comp B , 3 feet	1	3.5E-04	1.5E-04	ND	7.0E-05	3.7E-05
V458, 3 feet	1	5.7E-03	2.3-03	1.6E-04	ND	ND
V 453, 3 feet	1	9.9E-04	1.9E-04	2.0E-05	ND	4.5E-05
	2	1.4E-03	1.2E-03	1.4E-04	2.5E-04	ND
ARC 451	1	ND	BBL	ND	ND	ND
ARC 452A	1	ND	BBL	ND	ND	ND

* ND = Not detected, see Table E13 for detection limits. BBL = Below background level.

Table F15. VOC, CO_2 and CO concentration in each collected SUMMA canister sample.#

Sample / Compound	Ambient µg/m^3	Ambient µg/m^3	Comp B 3 feet µg/m^3	V453 3 feet µg/m^3	V453 3 feet µg/m^3	V 548 3 feet µg/m^3	ARC 451 µg/m^3	ARC 452A µg/m^3
Propene	0.59 [0.20]	ND [1.9]	48 [2.3]	6.2 [0.24]	7.3 [0.26]	7.7 [0.43]	1.5 [0.20]	2.8 [0.32]
1,3-Butadiene*	ND [0.24]	ND [2.4]	ND [2.8]	1.6 [0.29]	1.4 [0.32]	1.2 [0.52]	ND [0.24]	ND [0.40]
Bromomethane*	ND [0.21]	ND [2.1]	ND [2.4]	2.4 [0.26]	ND [0.28]	ND [0.46]	ND [0.21]	ND [0.35]
Ethanol	2.7 [1.4]	ND [1.4]	18 [16]	2.6 [1.7]	18 [1.8]	ND [3.0]	2.0 [1.4]	ND [2.3]
Acetonitrile	ND 0.36]	ND [3.5]	150 [4.2]	52 [0.44]	33 [0.48]	21 [0.79]	0.82 [0.36]	ND [0.60]
Acrolein*	0.54 [0.30]	ND [2.9]	5.6 [3.5]	4.9 [0.37]	1.7 [0.40]	ND [0.66]	0.96 [0.30]	0.76 [0.50]
Acetone	11 [1.7]	17 [16]	170 [19]	26 [2.0]	30 [2.2]	44 [3.6]	22 [1.7]	29 [2.7]
2-Propanol (Isopropyl Alcohol)	1.0 [0.51]	ND [5.0]	53 [5.9]	0.91 [0.62]	ND [0.68]	ND [1.1]	1.6 [0.51]	3.0 [0.84
Acrylonitrile*	ND [0.27]	ND [2.6]	ND [3.1]	6.6 [0.33]	4.4 [0.36]	ND [0.59]	ND [0.27]	ND [0.45]
Carbon Disulfide*	0.25 [0.20]	2.0 [1.9]	9.7 [2.3]	0.88 [0.24]	1.1 [0.26]	0.69 [0.43]	0.63 [0.20]	2.2 [0.32]
trans-1,2-Dichloroethene	ND [0.23]	ND [2.2]	ND [2.6]	ND	1.3 [0.30]	1.7 [0.49]	ND [0.23]	ND [0.37]
Vinyl Acetate*	ND [0.91]	ND [8.8]	ND [10]	3.2 [1.1]	1.9 [1.2]	ND [2.0]	ND [0.90]	ND [1.5]
2-Butanone (methyl ethyl ketone)	ND [0.30]	ND [2.9]	11 [3.5]	3.8 [0.37]	6.0 [0.40]	ND [0.66]	6.0 [0.30]	2.7 [0.50]
Ethyl Acetate	ND [0.48]	ND [4.7]	ND [5.6]	ND [0.59]	4.4 [0.64]	ND [1.0]	ND [0.48]	ND [0.79]
n-Hexane*	ND [0.24]	ND [2.4]	ND [2.8]	ND [0.29]	1.1 [0.32]	2.1 [0.52]	ND [0.24]	ND [0.40]
Chloroform*	ND [0.21]	ND [2.1]	ND [2.4]	ND [0.26]	ND [0.28]	ND [0.46]	0.50 [0.21]	ND [0.35]
Tetrahydrofuran (THF)	1.3 [0.39]	ND [3.8]	ND [4.5]	ND [0.48]	4.6 [0.52]	1.9 [0.85]	2.4 [0.39]	ND [0.64]
Benzene*	ND [0.21]	ND [2.1]	33 [2.4]	17 [0.26]	14 [0.28]	31 [0.46]	ND [0.21]	ND [0.35]
Carbon Tetrachloride*	0.24 [0.23]	ND [2.2]	ND [2.6]	0.52 [0.27]	ND [0.30]	ND [0.49]	1.4 [0.23]	0.95 [0.37]

Sample / Compound	Ambient µg/m^3	Ambient µg/m^3	Comp B 3 feet µg/m^3	V453 3 feet µg/m^3	V453 3 feet µg/m^3	V 548 3 feet µg/m^3	ARC 451 µg/m^3	ARC 452A µg/m^3
n-Heptane	ND [0.21]	ND [2.1]	ND [2.4]	ND [0.26]	1.7 [0.28]	0.81 [0.46]	ND [0.21]	ND [0.35]
4-Methyl-2-pentanone	0.44 [0.24]	ND [2.4]	4.9 [2.8]	0.53 [0.29]	1.1 [0.32]	ND [0.52]	3.8 [0.24]	1.2 [0.40]
Toluene*	0.22 [0.21]	ND [2.1]	15 [2.4]	3.8 [0.26]	12 [0.28]	13 [0.46]	0.31 [0.21]	0.37 [0.35]
2-Hexanone	ND [0.29]	ND [2.8]	ND [3.3]	0.64 [0.35]	0.77 [0.38]	ND [0.62]	1.2 [0.29]	0.72 [0.47]
n-Octane	ND [0.21]	ND [2.1]	ND [2.4]	ND [0.26]	0.32 [0.28]	ND [0.46]	ND [0.21]	ND [0.35]
Ethylbenzene	ND [0.23]	ND [2.2]	ND [2.6]	0.34 [0.27]	1.4 [0.30]	0.89 [0.49]	ND [0.23]	ND [0.37]
m,p-Xylenes*	ND [0.44]	ND [4.3]	6.5 [5.0]	ND [0.53]	1.8 [0.58]	ND [0.95]	ND [0.44]	ND [0.72]
Styrene*	ND [0.23]	ND [2.2]	ND [2.6]	0.92 [0.27]	0.85 [0.30]	ND [0.49]	ND [0.23]	ND [0.37]
o-Xylene*	ND [0.24]	ND [2.4]	ND [2.8]	ND [0.29]	0.64 [0.32]	ND [0.52]	ND [0.24]	ND [0.40]
n-Nonane	ND [0.21]	ND [2.1]	2.9 [2.4]	ND [0.26]	0.55 [0.28]	ND [0.46]	ND [0.21]	ND [0.35]
1,2,4-Trimethylbenzene	ND [0.23]	ND [2.2]	3.5 [2.6]	ND [0.27]	0.44 [0.30]	ND [0.49]	ND [0.23]	ND [0.37]
d-Limonene	ND [0.26	ND [2.5]	ND [3.0]	0.57 [0.31]	1.1 [0.34]	ND [0.56]	ND [0.26]	ND [0.42]
Naphthalene*	ND [0.32]	ND [3.1]	ND [3.7]	0.39 [0.38]	ND [0.42]	ND [0.69]	ND [0.32]	ND [0.52]
CO_2 ppmV	290 <0.11>	370 <0.11>	460 <1.3>	390 <0.14>	380 <0.15>	370 <0.25>	450 <0.11>	400 <0.19>
CO ppmV	ND <0.17>	ND <0.16>	100 <1.9>	15 <0.20>	10 <0.22>	11 <0.36>	ND <0.17>	ND <0.27>

ND=Not detected, detection limit within parentheses. Method reporting limit within arrows. *Included in the USEPA list of hazardous air pollutants (HAP). Munitions samples here are not corrected for ambient air concentrations.

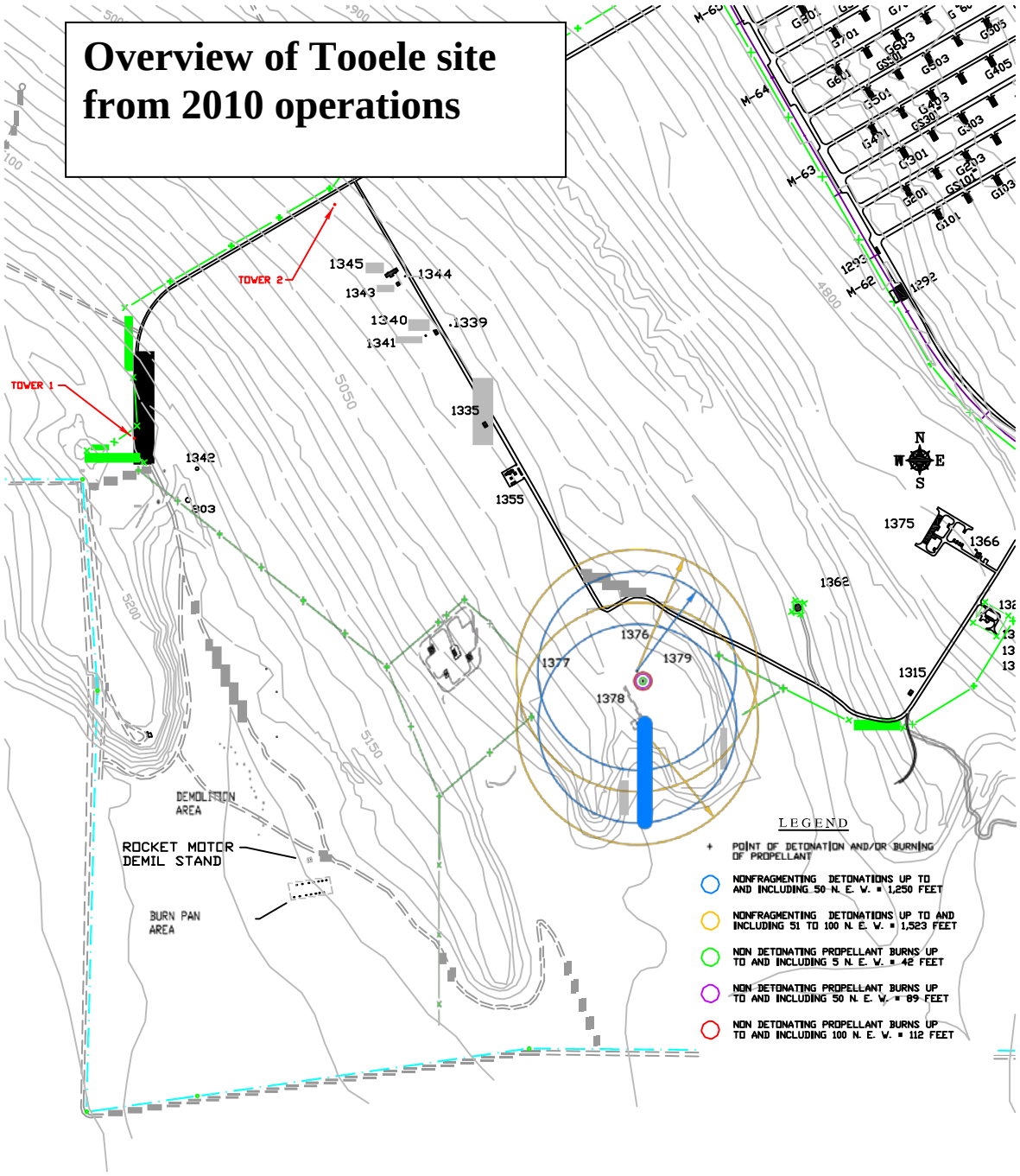
Table F16. Particle emission factor (lb/lb NEW) comparison for three OD series. Simultaneous measurements with batch filter sampling and continuous light-scattering measurements (DustTrak).

SERIES		PM10			PM2.5		
		Filter	DustTrak	DustTrak*	Filter	DustTrak	DustTrak*
V453	**3 feet**	258	0.35	0.63	7.7	0.51	0.92
V548	**3 feet**	278	1.4	2.5	19	1.2	2.2
V548	**3 feet**	268	1.3	2.3	6.7	0.54	0.97

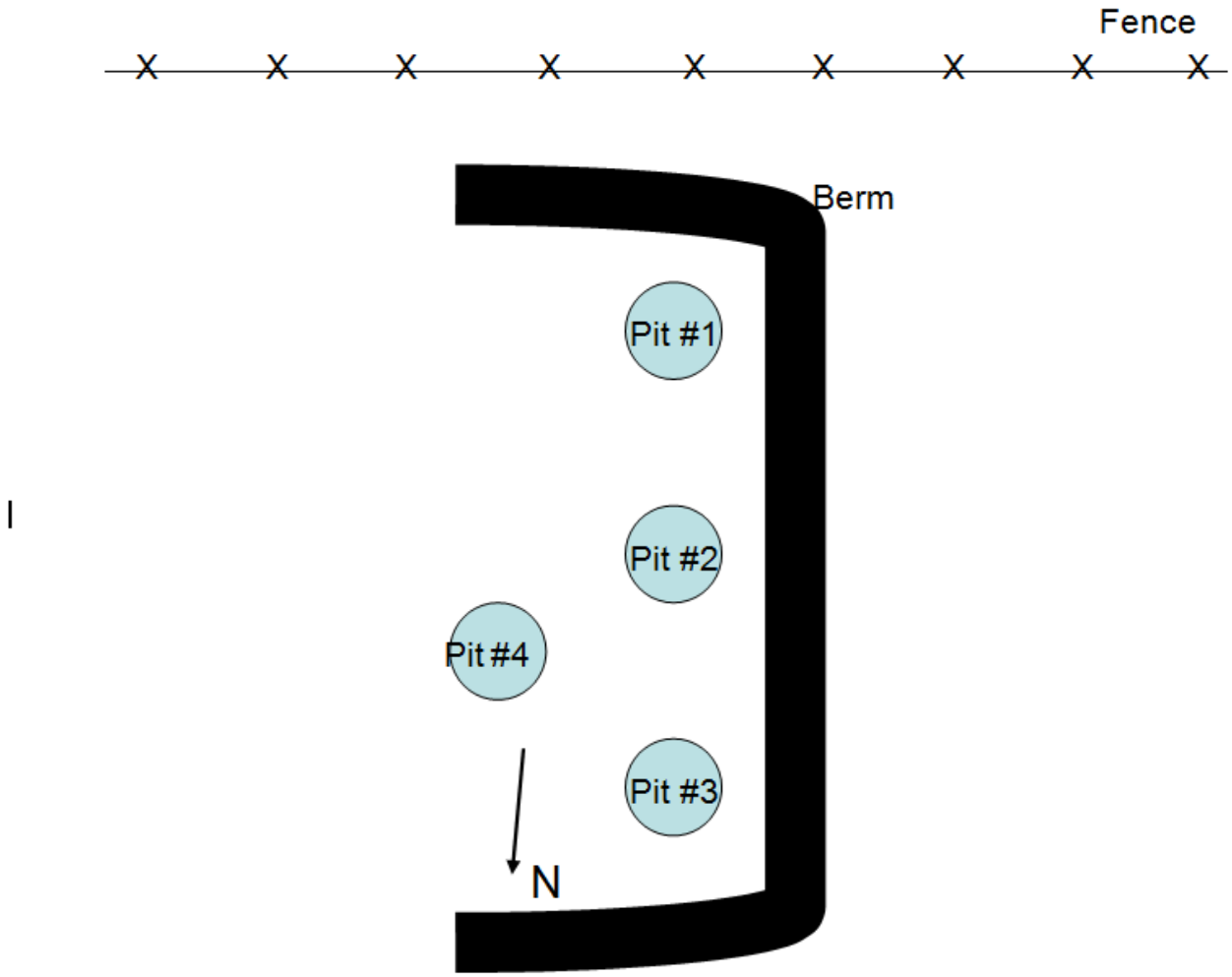
* Concentrations corrected using the custom photometric calibration factor (PCF) of 1.8.

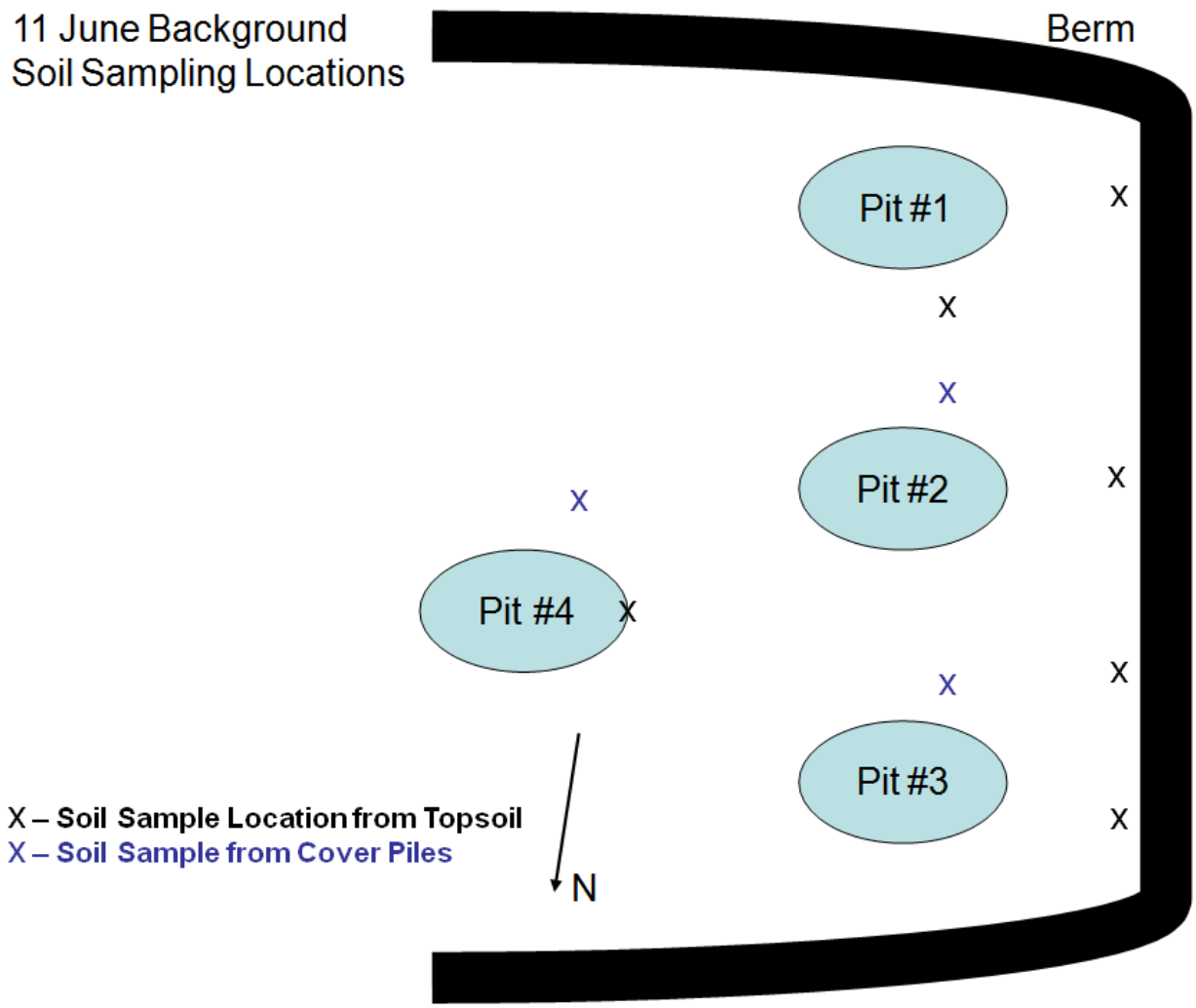
The high PM mass loadings from many of the V453 and V548 detonations saturated many of the optical PM channels on the DustTrak, rendering the data uninterpretable. Eight of fourteen open detonations resulted in saturation of the light-scattering Total PM and PM_{10} optical channels (instrument saturation >150 mg/m^3). For some detonations (three of fourteen) all of the channels were saturated. Only three of the detonations resulted in all PM channels less than 150 mg/m^3. A custom Total PM PCF of 1.8 could only be derived from five non-directly compared gravimetric versus light-scattering concentrations since the total PM light-scattering channel was saturated for many of the detonations. This custom PCF was used to correct the PM_{10}, PM_4, $PM_{2.5}$ and PM_1 light-scattering channel concentrations since most of the PM existed as PM_1.

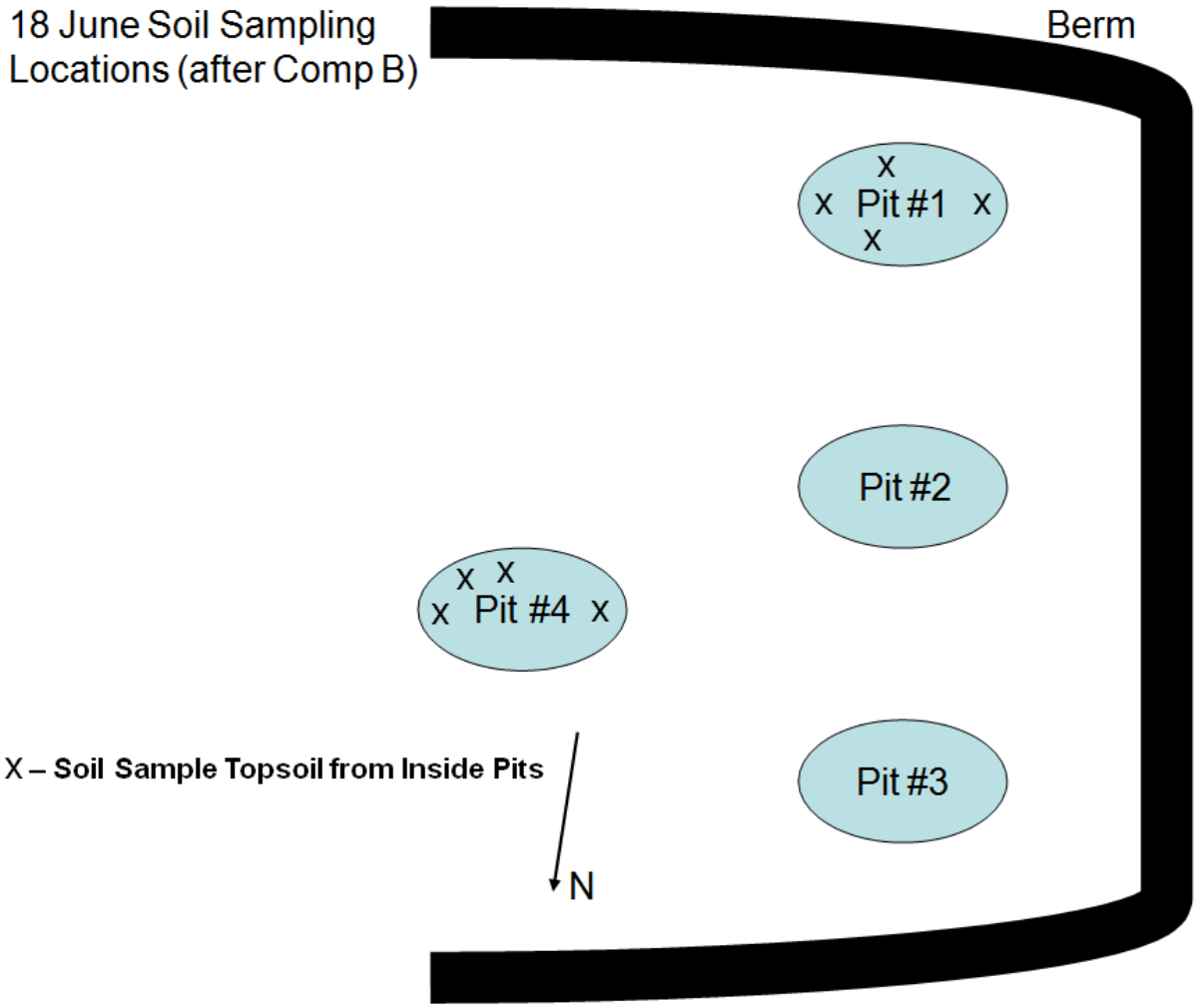
Appendix G: Site Diagrams: OD Locations, OB Locations, and Soil Sampling Sites.



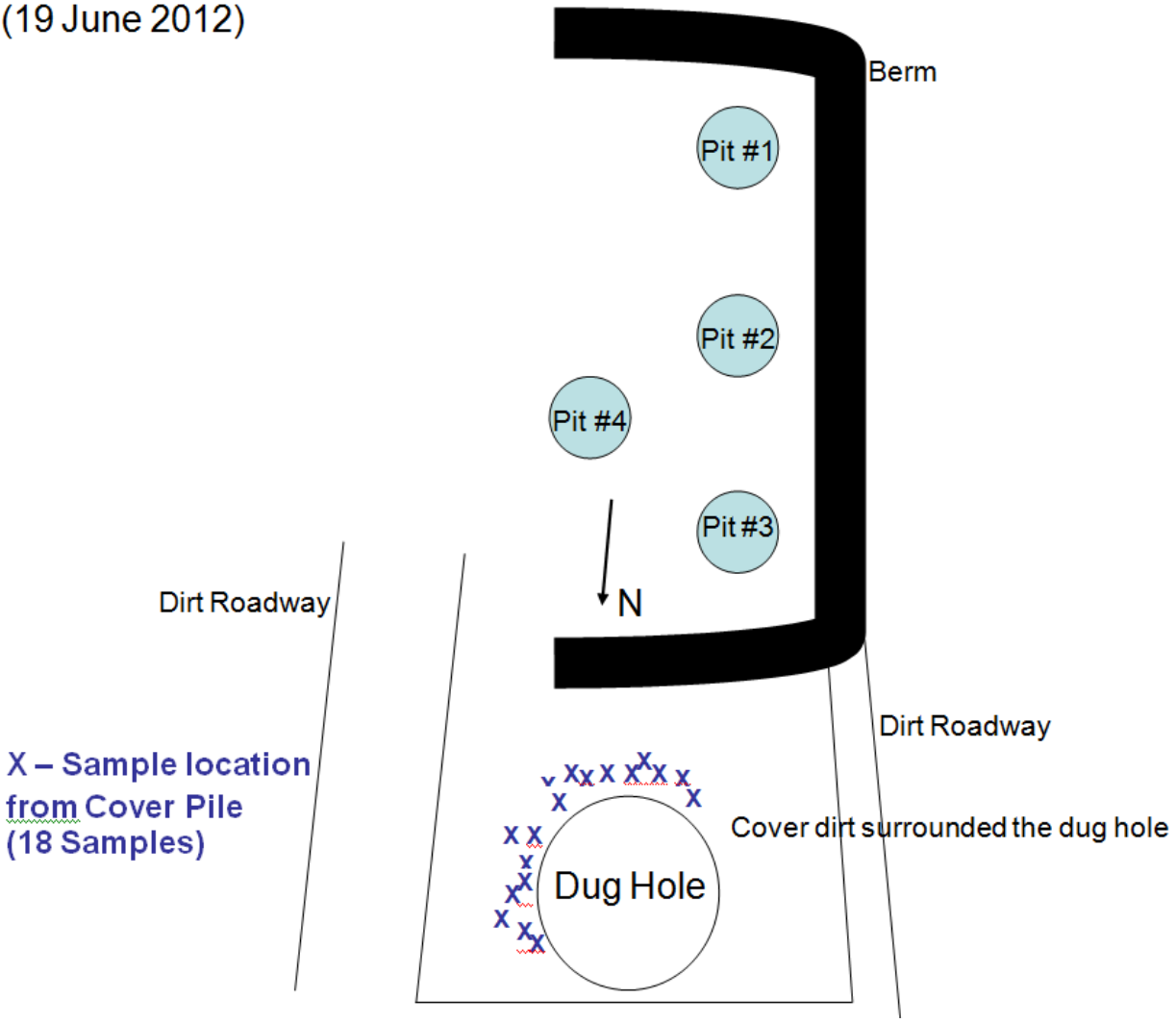
Sampling Layout (not to scale)



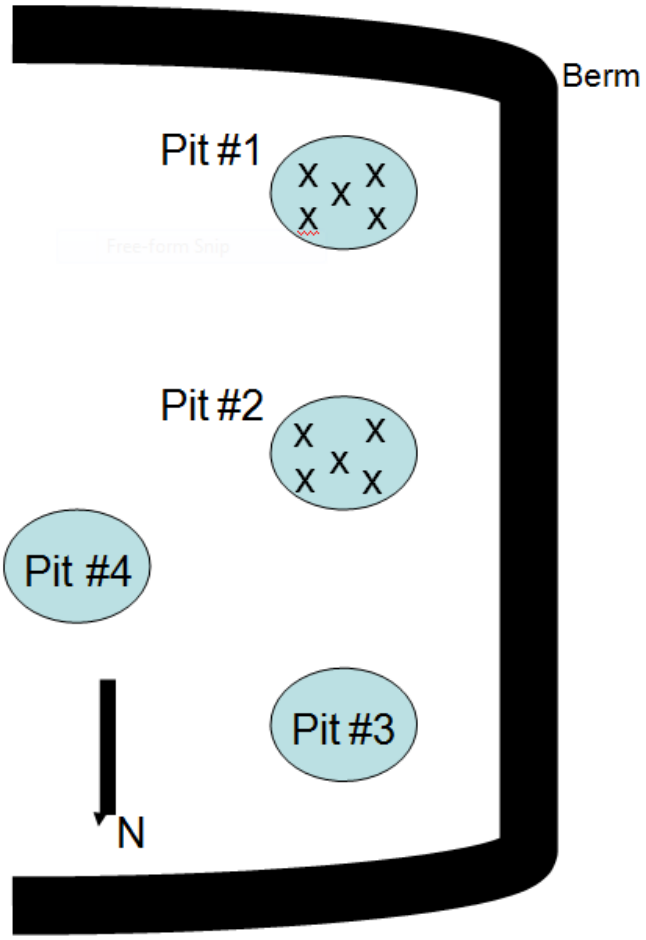

11 June Background
Soil Sampling Locations
Berm
Pit #1
Pit #2
Pit #3
Pit #4
X – Soil Sample Location from Topsoil
X – Soil Sample from Cover Piles
N


18 June Soil Sampling
Locations (after Comp B)
Berm
x
x Pit #1 x
x
Pit #2
x x
x Pit #4 x
X – Soil Sample Topsoil from Inside Pits
Pit #3
N

Background Soil Sampling of Cover Pile
(19 June 2012)

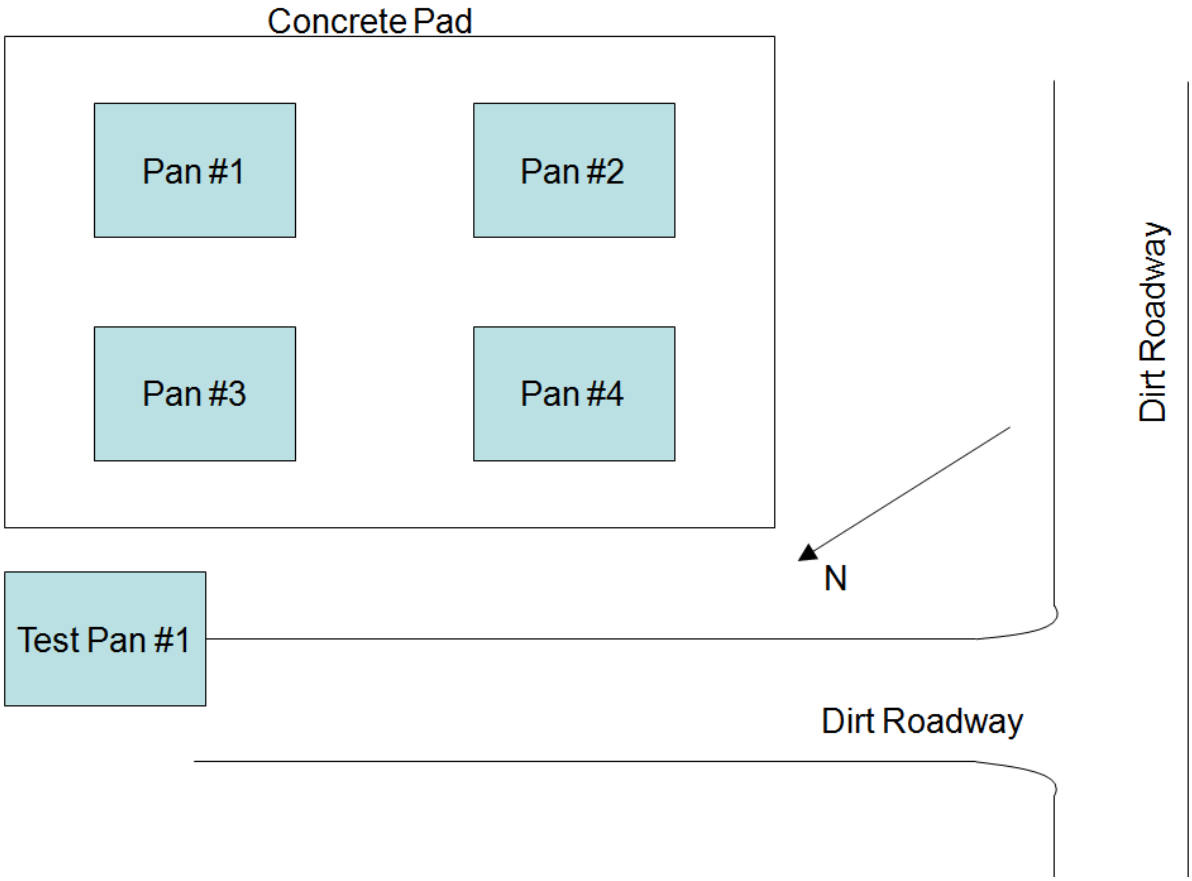


Soil Sampling after V453
(22 June 2012)

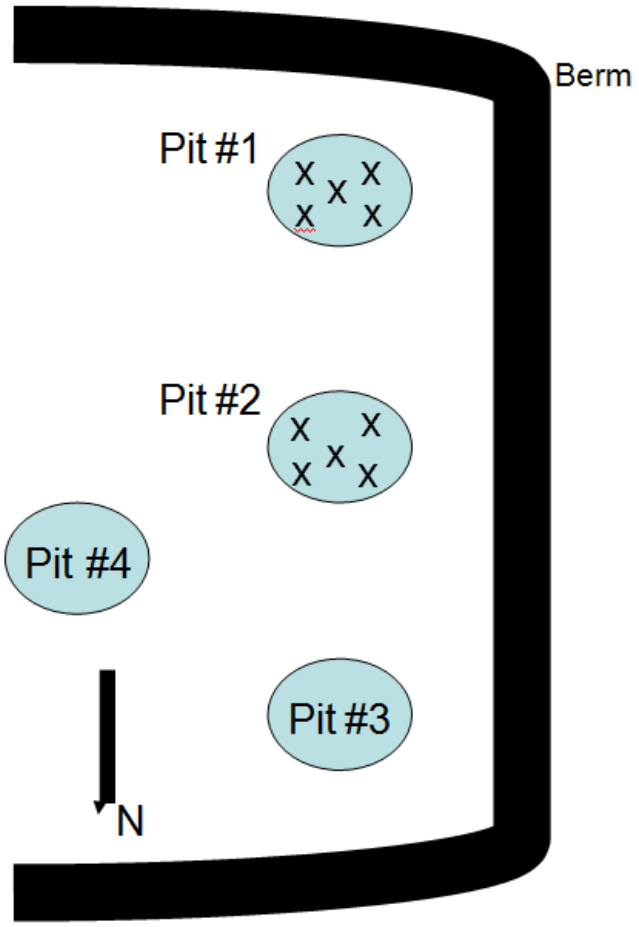


X – Sample location from Inside pits (10 Samples)

27 June 2012 Open Burning Pan Setup



Soil Sampling at Testing Completion – after V548
(28 June 2012)



X – Sample location from Inside pits (10 Samples)

Lab Work Order #

Page 1 of 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-061312	061312 061412		Comp B Surface	PM 2.5	12-T1301	X	X	X	X	X	X	X				
PS-OD-PM2.5-062712-02	062712		Comp B Surface	PM 2.5	12-T1838	X	X	X	X	X	X	X				
PS-OD-PM2.5-061412	061412 061512		Comp B 6 feet	PM2.5	12-T1303	X	X	X	X	X	X	X				
PS-OD-PM2.5-061512	061512		Comp B 6 feet	PM2.5	12-T1802	X	X	X	X	X	X	X				
PS-OD-PM2.5-061812-02	061812 061912		V453 6 feet	PM2.5	12-T1813	X	X	X	X	X	X	X				
PS-OD-PM2.5-062112-01	062112		V453 6 feet	PM 2.5	12-T1818	X	X	X	X	X	X	X				

Requested Analyses	
1	Weight
2	Pb, Cd
3	Zr, Na
4	Mn, Mg
5	Al, K
6	Fe
7	Hf

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/14/12		[signature] 8/16/12 9:15				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

Page 1 of ~~1~~ 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Soil

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX		Jar #	1	2	3	4	5	6	7	8	9	10	Remarks
						Requested Analyses										
BS-Soil-061112	061112		Background, pit soil		478493	X	X	X	X	X	X	X				12-58
PD-Soil-Comp B-061812	061812		Post Detonation Comp B		255288	X	X	X	X	X	X	X				12-59
BS-Soil-061912	061912		Background, sand fill		255289	X	X	X	X	X	X	X				12-510
PD-Soil-V453-062212	062212		Post detonation V453		478494	X	X	X	X	X	X	X				12-511
PD-Soil-V548-062812	062812		Post Detonation V548			X	X	X	X	X	X	X				12-512

Requested Analyses	
1	Pb, Cd
2	Zr, Na
3	Mn, Mg
4	Al, K
5	Fe
6	Hf
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/6/12		[signature] 9:17 8-16-12				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

Lab Work Order #

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-061612-01	061612		Comp B 3feet	PM2.5	12-T1302 ✓ P0219199	X	X									
PS-OD-PM2.5-061612-02	061612		Comp B 3feet	PM2.5	12-T1803 ✓ P0458953	X	X									
PS-OD-PM2.5-061612-03	061612		Comp B 3feet	PM2.5	12-T1804 ✓ P0458954	X	X									
PS-OD-PM2.5-061812-01	061812		Comp B 3feet	PM2.5	12-T1811 ✓ P0458961	X	X									
PS-OD-PM2.5-061912-01	061912		Warhead 6feet	PM2.5	12-T1812 ✓ P0458902	X	X									
BS-OD-PM2.5-062012	062012		Background	PM2.5	12-T1821 ✓ P0458971	X	X									
PS-OD-PM2.5-062112-02-OR	062112		Warhead 3feet	PM2.5	12-T1819 ✓ P0458969	X	X									
PS-OD-PM2.5-062112-03	062112		Warhead 3feet	PM2.5	12-T1820 ✓ P0458970	X	X									
PS-OD-PM2.5-062112-04-OR	062112		Warhead 3feet	PM2.5	12-T1825 ✓ P0458975	X	X									
PS-OD-PM2.5-062212-01-W1	062212		V548 3feet	PM2.5	12-T1828 ✓ P0458978	X	X									

Requested Analyses	
1	Weight
2	XRF + Hf
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	112012		[signature] 11-30-12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

Lab Work Order #

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-062312-02-OR	062312		Warhead 3feet	PM2.5	~~PS-OD-P~~ 12-71831 P045 8981	X	X									Ground
PS-OD-PM2.5-062312-01-	062312		V548 3 feet	PM2.5	12-T 1824 P045 8974	X	X									Ground
PS-OD-PM2.5-062512-01	062512		V548 3feet	PM2.5	12-T1833 P045 8983	X	X									Ground
PS-OD-PM2.5-062512-02-OR	062512		V548 3feet	PM2.5	12-T1836 P045 8986	X	X									Ground
PS-OD-PM2.5-062512-03	062512		V548 3feet	PM2.5	12-T1832 P045 8982	X	X									Ground
PS-OD-PM2.5-062512-04-OR	062512		548 3feet	PM2.5	12-T1834 P045 8984	X	X									Ground
PS-OD-PM2.5-062612-01	062612		V548 3feet	PM2.5	12-T1843 P045 8993	X	X									
PS-OD-PM2.5-062712-01	062712		548 3feet	PM2.5	12-T1850 P045 9000	X	X									
BS-OD-PM2.5-062812	062812		Ambient air	PM2.5	12-T1844 P045 8994	X										

Requested Analyses	
1	Weight
2	XRF+HG
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11/30/12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10

Lab Work Order #

Page 1 of 2

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10-0 061612-01	061612		Comp B 3 feet	PM10	12-T1806 P0458956	X	X									
PS-OD-PM10-061612-02	061612		Comp B 3 feet	10	12-T1810 P0458960	X	X									
PS-OD-PM10-061612-03	061612		Comp B 3 feet	10	12-T1809 P0458959	X	X									
PS-OD-PM10-061812-01	061812		Comp D 3 feet	10	12-T1814 P0458964	X	X									
PS-OD-PM10-061912-01	061912		Warhead 6 feet	10	12-T1817 P0458967	X	X									
PS-OD-PM10-062012-01	062012		Ambient	10	12-T1823 P0458973	X	X									
PS-OD-PM10-062112-02-OR	062112		Warhead 3 feet	10	12-T1822 P0458972	X	X									
PS-OD-PM10-062112-03	062112		Warhead 3 feet	10	12-T1816 P0458966	X	X									
PS-OD-PM10-062112-04-OR	062112		Warhead 3 feet	10	12-T1827 P0458977	X	X									
PS-OD-PM10-062212-01-W1	062212		V548 3 feet	10	12-T1829 P0458979	X	X									

Requested Analyses	
1	Weight
2	~~ICP XRF Hf~~ XRF+ Hf
3	~~Zr~~
4	~~Hf~~
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[illegible]	112012		[illegible]				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD -PM10 - 062312-01	062312		V548 3feet	10	12-71835 P0458985	X	X									Ground
PS-OD- PM10 - 062312-02-OR	062312		V548	10	12-71830 P0458980	X	X									Ground
PS-OD - PM10 - 062512-01	062512		V548 3feet	10	12-71837 P0458987	X	X									Ground
PS-OD- PM10 - 062512-02-OR	062512		V548 3feet	10	12-71841 P0458991	X	X									Ground
PS-OD - PM10 - 062512-03	062512		V548 3feet	10	12-71842 P0458992	X	X									Ground
PS-OD- PM10 - 062512-04-OR	062512		548 3feet	10	12-71840 P0458990	X	X									
PS-OD-PM10- 062612-01	062612		548 3feet	10	12-71847 P0458997	X	X									
PS-OD- PM10 - 062712-01	062712		548 3feet	10	12-71851 P0459651	X	X									
BS-OD- PM10 - ~~062812~~ 062812	062812		Ambient	10	12-71853 P0460353	X										

Requested Analyses	
1	Weight
2	XRF+ Hf
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11/20/12 L. Bell 17:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

Page 1 of 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10 Imp. > PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
~~PM10Imp~~ - PS-00-PM10Imp-061612-01	061612		Comp B 3feet	710	JA99	X	X	X	X	X	X	X	X	X	X	12-X1607
PS-00-PM10Imp-061612-02	061612		Comp B 3feet	710	JA104	X	X	X	X	X	X	X	X	X	X	X1608
PS-00-PM10Imp-061612-03	061612		Comp B 3feet	710	JA102	X	X	X	X	X	X	X	X	X	X	X1609
PS-00-PM10Imp-061812-01	061812		Comp B 3feet	710	JA107	X	X	X	X	X	X	X	X	X	X	X1610
PS-00-PM10Imp-061912-01	061912		Warhead 6feet	710	JA110	X	X	X	X	X	X	X	X	X	X	X1611
PS-00-PM10Imp-062012-01	062012		Ambient	710	JA116	X	X	X	X	X	X	X	X	X	X	X1612
PS-00-PM10Imp-062112-02-OR	062112		Warhead 3feet	710	JA115	X	X	X	X	X	X	X	X	X	X	X1613
PS-00-PM10Imp-062112-03	062112		Warhead 3feet	710	JA109	X	X	X	X	X	X	X	X	X	X	X1614
PS-00-PM10Imp-062112-04-OR	062112		Warhead 3feet	710	JA120	X	X	X	X	X	X	X	X	X	X	X1615
PS-00-PM10Imp-062212-01-W1	062212		548 3feet	710	JA125	X	X	X	X	X	X	X	X	X	X	X1616

Requested Analyses

1. ~~XRF~~ ICP 96
2. Zr - 8. Na -
3. Mn - 9. Mg -
4. Al - 10. K -
5. Fe -
6. Hf -
7. Ca -

Special Instructions/Comments:

Add loose particles in the petri dish to the filter for XRF

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
Glenn Bell	11-7-12		Lisa Bell 11-7-12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10 Imp. ? PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-00-PM10imp-062312-01	062312		548 3feet	710	JA123	X	X	X	X	X	X	X	X	X	X	Ground x1617
PS-00-PM10imp.-062312-02-OR	062312		548 3feet	710	JA 126	X	X	X	X	X	X	X	X	X	X	Ground x1618
PS-00-PM10imp-062512-01	062512		548 3feet	710	JA 130	X	X	X	X	X	X	X	X	X	X	Ground x1619
PS-00-PM10imp-062512-02-OR	062512		548 3feet	710	JA 134	X	X	X	X	X	X	X	X	X	X	Ground x1620
PS-00-PM10imp-062512-03	062512		548 3feet	710	JA 135	X	X	X	X	X	X	X	X	X	X	Ground x1621
PS-00-PM10imp.-062512-04-OR	062512		548 3feet	710	JA 133	X	X	X	X	X	X	X	X	X	X	Ground x1622
PS-00-PM10imp.-062612-01	062612		548 3feet	710	JA 141	X	X	X	X	X	X	X	X	X	X	x1623
PS-00-PM10imp.-062712-01	062712		548 3feet	710	JA 145	X	X	X	X	X	X	X	X	X	X	x1624

Requested Analyses	
1	~~XRF + Hf~~ ICP Pb
2	Zr 8, Na
3	Mn 9, Mg
4	Al 10. K
5	Fe
6	Hf
7	Ca

Special Instructions/Comments:

Include loose particles for XRF

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11-30-12 Liz Bell 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Lab Work Order # K120 4333

Page of

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
						Requested Analyses										
BS-Soil-061120	6/11/12	soil	255291			X	X	X								predetonation soil
PD-Comp-B-6182	6/18/12	soil	478495			X	X	X								post detonation comp B soil
BS-Sand fill	6/19/12	soil	478496			X	X	X								sand used as fill
PD-V453	6/22/12	soil	478492			X	X	X								post detonation V453
PD-Final	6/28/12	soil	255290			X	X	X								post detonation Final

	Requested Analyses
1	RDX
2	HMX
3	TNT
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☑ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
Robert Blank	6/29/12	0945					
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	6/30/12	9:20	Bm				

Lab Work Order # 1106334

Page 1 of 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

SVOC - RDX

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
						Requested Analyses										
PS-OD-SVOC - 061312	061312		Comp B Surface	Containment 6 365		X	X	X								Glass tube Weight pre: 4.71g post: 5.26
PS-OD-SVOC 061412	061412 061512		Comp B 8 first 6 feet			X	X	X								Weight pre 4.70 post 7.75 First and second series
PS-OD-SVOC - 061512	061512		Comp B 6 feet	4 last		X	X	X								Weight pre 4.65 post 6.69 Third series
PS-OD-SVOC - 061612	061612		Comp B 3 feet	First series		X	X	X								Weight Pre: 4.72g Post: 9.94g Willow holder
PS-OD-SVOC - 061612-02	061612		Comp B 3 feet	Series #2		X	X	X								Weight Pre: 4.74g Post 8.85g Orville holder
PS-OD-SVOC - 061612-03	061612		Comp B 3 feet	Series #3		X	X	X								Weight Pre: 4.65g Post 6.96g Willow holder
PS-OD-SVOC - 061812-01	061812		Comp B 3 feet	First series		X	X	X								Weight Pre: 4.72g Post: 5.82g Orville holder
PS-OD-SVOC - 061812-#02	061812 061912		Wet wood 6 feet (1)	First seng First seng	061912 061912	X	X	X								Weight Pre: 4.67g Post: 5.18g Willow holder
PS-OD-SVOC - 061912	061912		Wet wood (3) 6 feet	Second Hand series		X	X	X								Weight: Pre 4.80g Post 5.61g Orville holder
PS-OD-SVOC - 062012	062012		Ambient	Dirty Ambient		X	X	X								Weight Pre 4.60g Post 4.66g Willow holder

Requested Analyses	
1	RDX
2	HMX
3	TNT
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	9/29/12						
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	9/30/12	920	[signature]				

Lab Work Order # K1206334

Page 2 of 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

SVOC- RDX

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-SVOC-062112-01	062112		Warhead 6feet			X	X	X								Weight pre: 4.55 post: 5.01 First series
PS-OD-SVOC-062112-02	062112		Warhead 3feet			X	X	X								Weight pre: 4.60 post: 7.47g Second series
PS-OD-SVOC-062212	062212		V548 3feet			X	X	X								Weight pre 4.48g post 5.92g First and second series
PS-OD-SVOC-062312	062312		V548 3feet													Weight pre: 4.57g post 4.89g Ground Blower not ON
PS-OD-SVOC-062512-01	062512		V548 3feet			X	X	X								Weight pre: 4.53 post 6.46g Ground First series
PS-OD-SVOC 062512-02	062512		V548 3feet			X	X	X								Weight pre: 4.49g post 6.79g Ground Second series
PS-OD-SVOC 062612-01	062612		V548 3feet			X	X	X								Weight pre: 4.55g post: 5.97 First and second series
						X	X	X								

Requested Analyses	
1	RDX
2	HMX
3	TNT
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	6/29/12						
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	6/30/12	9:30	[signature]				

Columbia Analytical Services
2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

P1202679

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. 31 670

Company Name & Address (Reporting Information): ARCADIS U.S., INC. PO Box 13109, Research Triangle Park, NC 27709

Project Name: Air testing Tooele

Project Number:

CAS Contact: Sue Anderson

Project Manager: Dahman Touati

P.O. # / Billing Information: R B70911

Phone: 919-541-3662 Fax: 919-541-9417

Email Address for Result Reporting: dahman.touati@arcadis-us.com

Sampler (Print & Sign): Johanna Avell / Johanna Avell

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code #- FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method: TO-15	Analysis Method: 25CM 10.02	Comments e.g. Actual Preservative or specific instructions
BS-OD-061912	1 -2.11	061912		SC01611				6L	x	x	
PS-OD-061612	2 -1.33	061612		SC00503					x	x	Lamp B 3 feet
BS-OD-062012	3 -2.05	062012		SC00633				6L	x	x	
PS-OD-SC-062112-01	4 -1.54	062112		SC01556		25	5	6L	x	x	wer mad 3 feet
PS-OD-SC-06212-02	5 -5.46	062112		SC00314		25	7	6L	x	x	-"-
PS-OD-SC-062312-01	6 -6.57	062312		SC00102		25	14	6L	x	x	V548
PS-OD-SC-062512-01	7 -7.54	062512		SC01605		25	11	6L	x	x	V548
PS-OB-SC-062712-01	8 -2.44	062712		SC00166		25	0	6L	x	x	AP 451
PS-OB-SC-062712-02	9 -7.07	062712		SC00008		25	11	6L	x	x	AP 452A
PS-OD-SC-062712-01	10 -8.66	062712		SC01595		25	0	6L	x	x	548
PS-OD-SC-062712-02	11 -3.41	062712		SC00109		25	0	6L	x	x	Lamp B surface
BS-OD-SC-062812	12 -2.52	062812		SC01577		25	0	6L	x	x	Ambient
	-14.22										
	-14.21 -3										
	-14.20 -3										
	-14.15 -2										
	-14.08										
	-13.35										
	-13.54										
	-12.79										
	-8.56										

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date: 7/6/12	Time: 1020

Cooler / Blank Temperature ____ °C

COC AIR REV 3-11

Appendix I: Calibration Gases - Certificates of Analysis

Airgas

Airgas Intermountain
3415 South 700 West
Salt Lake City, UT 84119
(801) 288-5000 Fax: (801) 288-5087
(888) 918-9353 for nearest location

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P33A40M0	Reference Number:	18-104137953-4
Cylinder Number:	FF8297	Cylinder Volume:	31.6 CF
Laboratory:	IMT - Salt Lake City - UT	Cylinder Pressure:	2216 PSIG
Analysis Date:	Sep 01, 2011	Valve Outlet:	580

Product directly traceable to NIST ASTM Class 1 weights and/or NIST gas mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
CARBON DIOXIDE	4500 PPM	4499 PPM	+/- 1%
NITROGEN	Balance		

Notes:

S. Russell

Approved for Release

Page 1 of 18-104137953-4

GASES, WELDING & SAFETY PRODUCTS

Airgas

Airgas Intermountain
3415 South 700 West
Salt Lake City, UT 84119
(801) 288-5000 Fax: (801) 288-5087
(888) 918-9353 for nearest location

CERTIFICATE OF ANALYSIS

NITROGEN - ULTRA HIGH PURITY-PURE

Part Number:	NI UHP33ASRV	Reference Number:	18-104137953-2
Cylinder Analyzed:	FF8300	Cylinder Volume:	31 Cubic Feet
Laboratory:	IMT - Salt Lake City - UT	Cylinder Pressure:	2000 PSIG
Analysis Date:	Sep 02, 2011	Valve Outlet:	580
Lot #:	18-104137953-2		

ANALYTICAL RESULTS

Component	Requested Purity	Certified Concentration
NitrogenUltraHighPurity	99.999%	99.999%
CO + CO2	<1 PPM	0.04 PPM
Moisture	<1 PPM	0.8 PPM
Oxygen	<1 PPM	0.4 PPM
THC	<0.5 PPM	0.03 PPM

Notes:

Impurities verified against analytical standards traceable to NIST by weight and/or analysis.

M. Hernandez

Approved for Release

GASES, WELDING & SAFETY PRODUCTS

Airgas

Airgas Intermountain
3415 South 700 West
Salt Lake City, UT 84119
(801) 288-5000 Fax: (801) 288-5087
(888) 918-9353 for nearest location

Certificate of Analysis

Date: May 9, 2012

Lot Number: 18-104212433-1

Customer: 0

Product: Nitrogen
Grade: UHP-Servomex

Cylinder Number:	Required Concentration	Actual Concentration
FF9940	99.999%	>99.999% ± 0.0000092%

Analytical Results

Component	Requested Concentration	Actual Contration
Oxygen	0.000100%	0.000060% ± 0.0000060%
Moisture	0.000100%	0.000030% ± 0.0000030%
THC	0.000050%	0.000001% ± 0.0000001%
Carbon Dioxide and Carbon Monoxide	0.000100%	0.000001% ± 0.0000001%

Product compoents verified by direct comparison to calibration standards traceable to NIST weights and/or NIST gas mixture reference materials.

Method: Baseline THC Analyzer, Panametrics Moisture Analyzer, Delta F Oxygen Analyzer

Expiration Date: Not Required

Approval Signature

GASES, WELDING & SAFETY PRODUCTS

Airgas

Airgas Intermountain
3415 South 700 West
Salt Lake City, UT 84119
(801) 288-5000 Fax: (801) 288-5087
(888) 918-9353 for nearest location

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P33A38Z5	Reference Number:	18-104137953-3
Cylinder Number:	FF8272	Cylinder Volume:	31.6 CF
Laboratory:	IMT - Salt Lake City - UT	Cylinder Pressure:	2217 PSIG
Analysis Date:	Sep 08, 2011	Valve Outlet:	580

Product directly traceable to NIST ASTM Class 1 weights and/or NIST gas mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
CARBON DIOXIDE	400.0 PPM	400.1 PPM	+/- 1%
NITROGEN	Balance		

Notes:

S. Russell

Approved for Release

Page 1 of 18-104137953-3

GASES, WELDING & SAFETY PRODUCTS

Airgas

Airgas Intermountain
3415 South 700 West
Salt Lake City, UT 84119
(801) 288-5000 Fax: (801) 288-5087
(888) 918-9353 for nearest location

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P33AC128	Reference Number:	18-104137953-5
Cylinder Number:	FF8304@	Cylinder Volume:	31.6 CF
Laboratory:	IMT - Salt Lake City - UT	Cylinder Pressure:	2217 PSIG
Analysis Date:	Sep 01, 2011	Valve Outlet:	580

Expiration Date: Sep 01, 2014

Product directly traceable to NIST ASTM Class 1 weights and/or NIST gas mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
CARBON DIOXIDE	1500 PPM	1496 PPM	+/- 1%
NITROGEN	Balance		

Notes:

Approved for Release

Page 1 of 18-104137953-5

GASES, WELDING & SAFETY PRODUCTS

Appendix J: CO2 CEM Calibration and Drift Data

Analyzer Calibration Data

The LICORs CO2 analyzers underwent daily, 3-point calibrations. The calibration errors were calculated for each calibration point according to U.S. EPA Method 3A, using the following equation:

$$Calibration\ Error = \frac{Pre\ Cal - Cal\ gas}{Span\ gas}$$

Where

Pre Cal – Measured concentration of calibration gas.
Cal gas – Calibration gas concentration.
Span gas - in this case 4499 ppm.

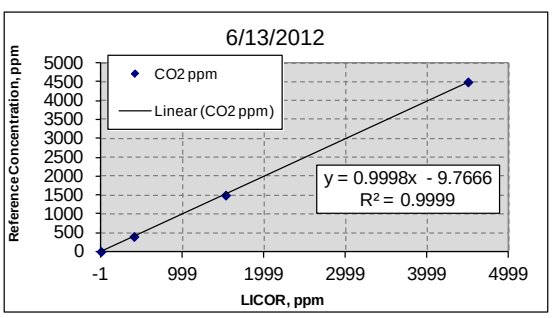
All calculated errors were below the <2% acceptance criteria as stated by the U.S. EPA Method 3A.

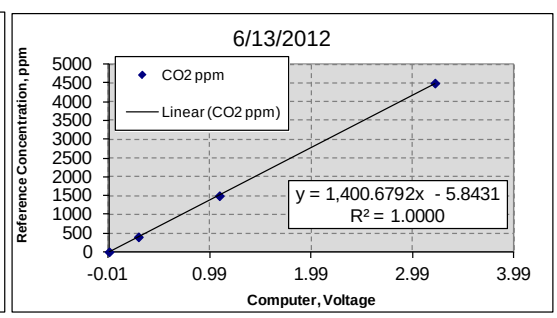
Key

LICOR-1 and computer-1 are mounted on the Wilbur Flyer.
LICOR-2 and computer-2 are mounted on the Orville Flyer.

6/13/2012

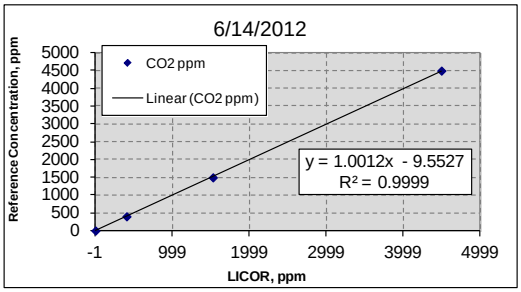
Cal gas (ppm)	LICOR-2 (ppm)	Computer-2 (Voltage)	Error (% of calibration span)
0	-0.040	-0.0021	-0.001
400	404	0.287	0.093
1496	1528	1.085	0.73
4499	4502	3.211	0.073

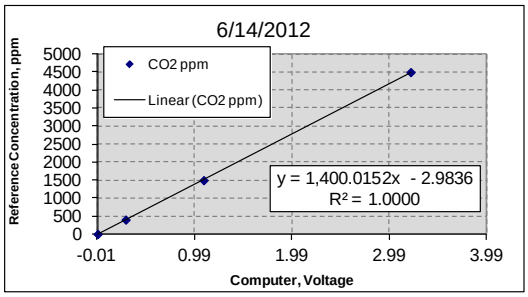




6/14/2012

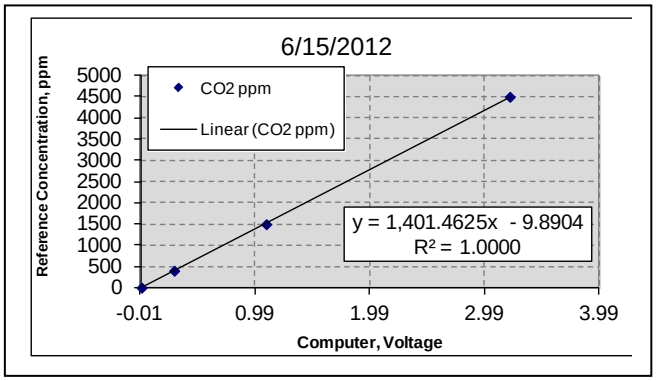
Cal gas (ppm)	LICOR-2 (ppm)	Computer-2 (Voltage)	Error (% of calibration span)
0	-0.31	-0.0037	-0.007
400	404	0.284	0.084
1496	1526	1.085	0.67
4499	4496	3.211	-0.06





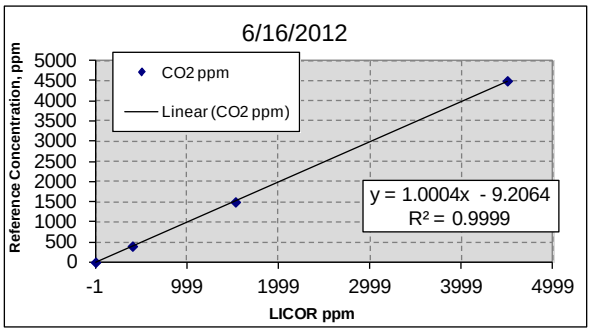
6/15/2012

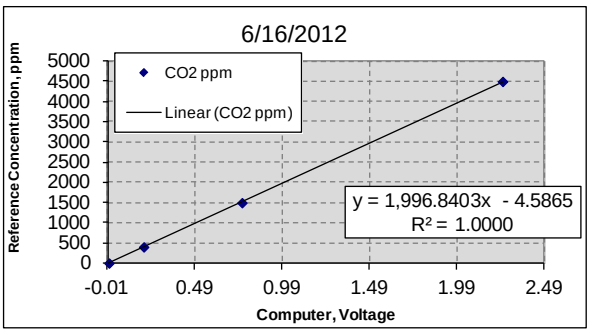
Cal gas (ppm)	Computer-2 (Voltage)
0	0.0023
400	0.287
1496	1.089
4499	3.213



6/16/2012

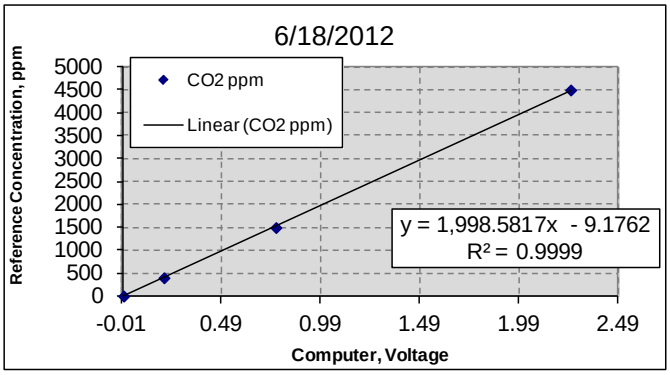
Cal gas (ppm)	LICOR-1 (ppm)	Computer-1 (Voltage)	Error (% of calibration span)
0	-0.319	-7E-05	-0.007
400	402	0.198	0.056
1496	1528	0.760	0.71
4499	4499	2.252	0.002





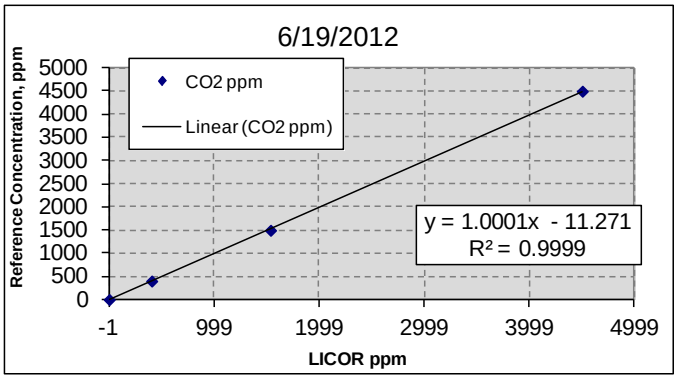
6/18/2012

Cal gas (ppm)	Computer-1 (Voltage)
0	-0.0013
400	0.202
1496	0.766
4499	2.252



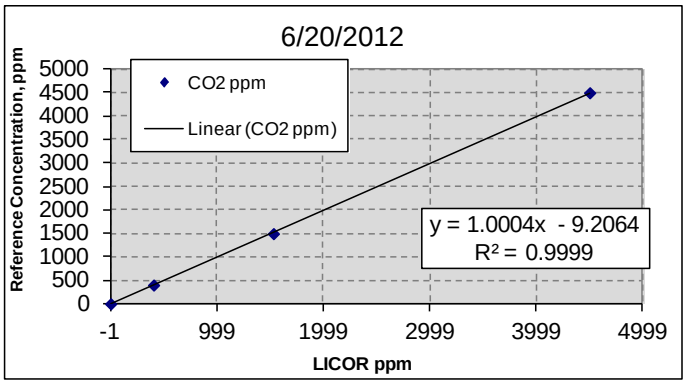
6/19/2012

Cal gas (ppm)	LICOR-1 (ppm)	Error (% of calibration span)
0	-0.10	-0.002
400	404	0.087
1496	1534	0.86
4499	4501	0.048



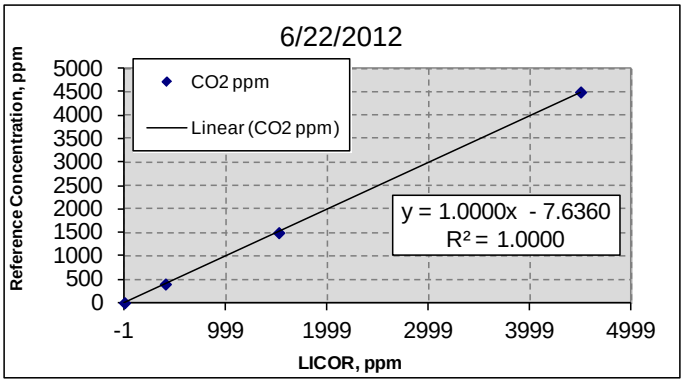
6/20/2012

Cal gas (ppm)	LICOR-1 (ppm)	Error (% of calibration span)
0	-0.32	-0.007
400	403	0.056
1496	1528	0.71
4499	4499	0.002



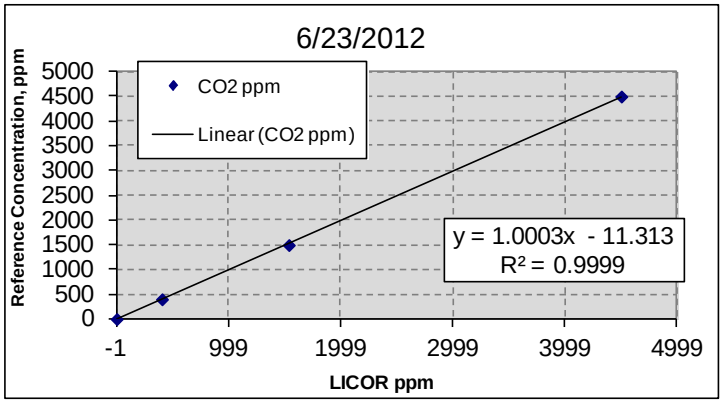
6/22/2012

Cal gas (ppm)	LICOR-2 (ppm)	Error (% of calibration span)
0	-0.22	-0.005
400	403	0.07
1496	1522	0.57
4499	4501	0.04



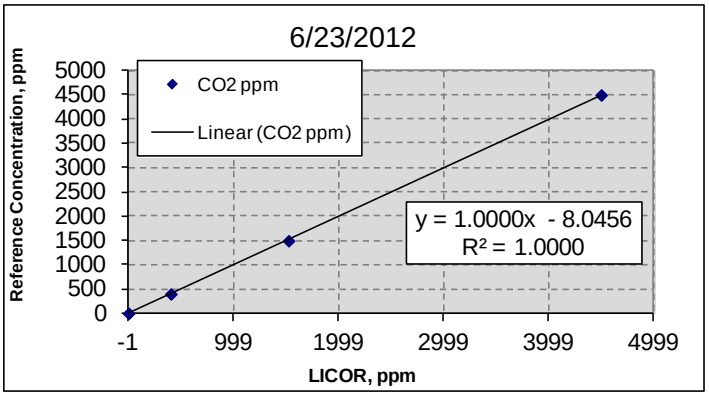
6/23/2012

Cal gas (ppm)	LICOR-1 (ppm)	Error (% of calibration span)
0	-0.20	-0.004
400	404	0.082
1496	1535	0.79
4499	4500	-0.04



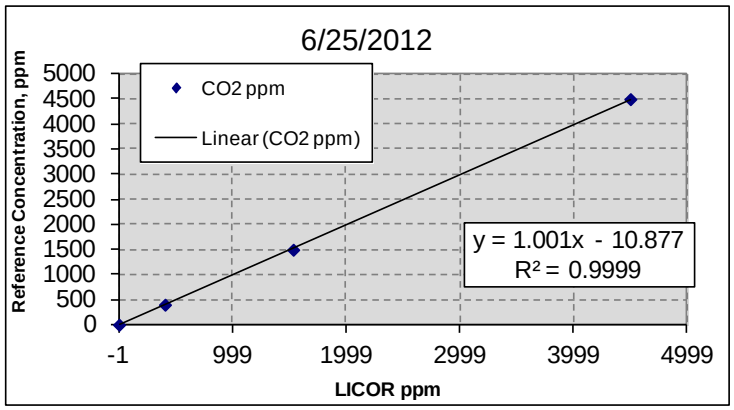
6/23/2012

Cal gas (ppm)	LICOR-2 (ppm)	Error (% of calibration span)
0	-0.023	-0.001
400	403	0.06
1496	1523	0.61
4499	4501	0.04



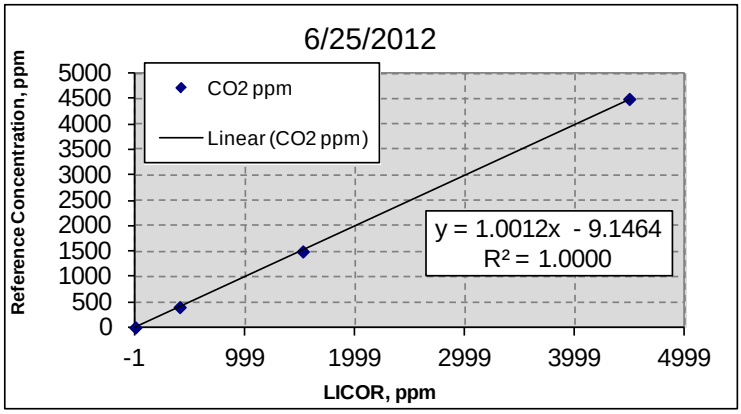
6/25/2012

Cal gas (ppm)	LICOR-1 (ppm)	Error (% of calibration span)
0	-0.18	-0.004
400	404	0.082
1496	1532	0.789
4499	4497	-0.040



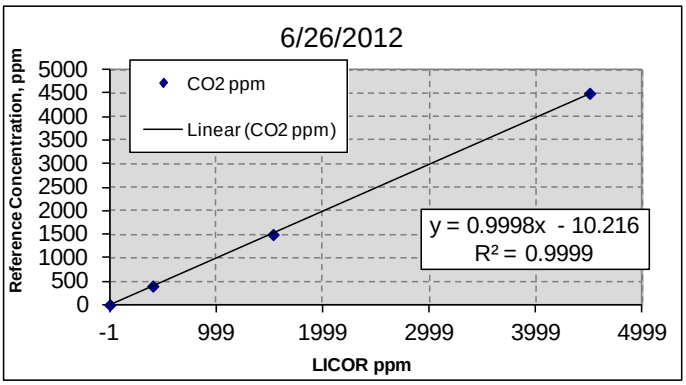
6/25/2012

Cal gas (ppm)	LICOR-2 (ppm)	Error (% of calibration span)
0	-0.26	-0.006
400	404	0.081
1496	1524	0.63
4499	4496	-0.069



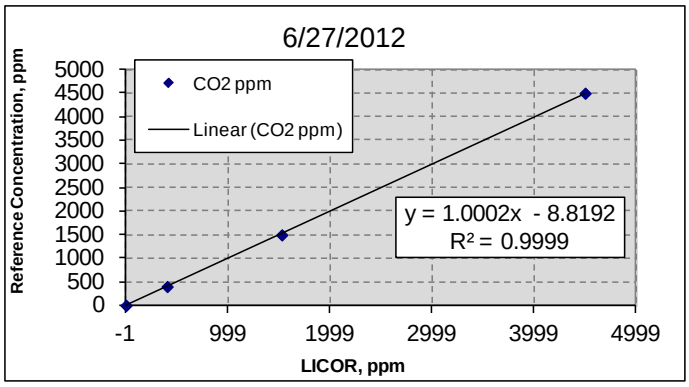
6/26/2012

Cal gas (ppm)	LICOR-1 (ppm)	Error (% of calibration span)
0	-0.20	-0.004
400	403	0.074
1496	1532	0.798
4499	4502	0.067



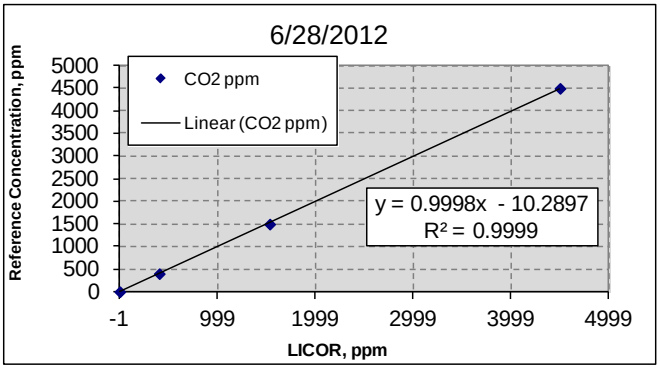
6/27/2012

Cal gas (ppm)	LICOR-2 (ppm)	Error (% of calibration span)
0	-0.33	-0.007
400	402	0.055
1496	1527	0.69
4501	4502	0.020



6/28/2012

Cal gas (ppm)	LICOR-2 (ppm)	Error (% of calibration span)
0	-0.39	-0.009
400	403	0.070
1496	1533	0.82
4499	4502	0.061



LICOR drift tests

The LICOR drift was calculated according to U.S. EPA Method 3A:

$$Drift = \frac{Post\ Cal - Pre\ Cal}{Span\ gas}$$

Where

Post Cal – Measured concentration of calibration gas after run.
Pre Cal – Measured concentration of calibration gas before run.
Span gas – in this case, 4499 ppm.

The system drift for each of the calibration concentrations were below the <±5% acceptance criteria as stated by the U.S. EPA Method 3A (Table 1 and Figure 1).

Table 1. Carbon dioxide drift data for LICOR-1 and LICOR-2.

CO_2 Calibration gas (ppm)	LICOR-1		LICOR-2	
	Drift average (%)	Drift STDV	Drift average (%)	Drift STDV
0	0.018	0.023	0.0059	0.018
400	0.055	0.018	-0.035	0.035
1496	0.090	0.021	-0.069	0.031
4499	0.11	0.024	-0.23	0.057

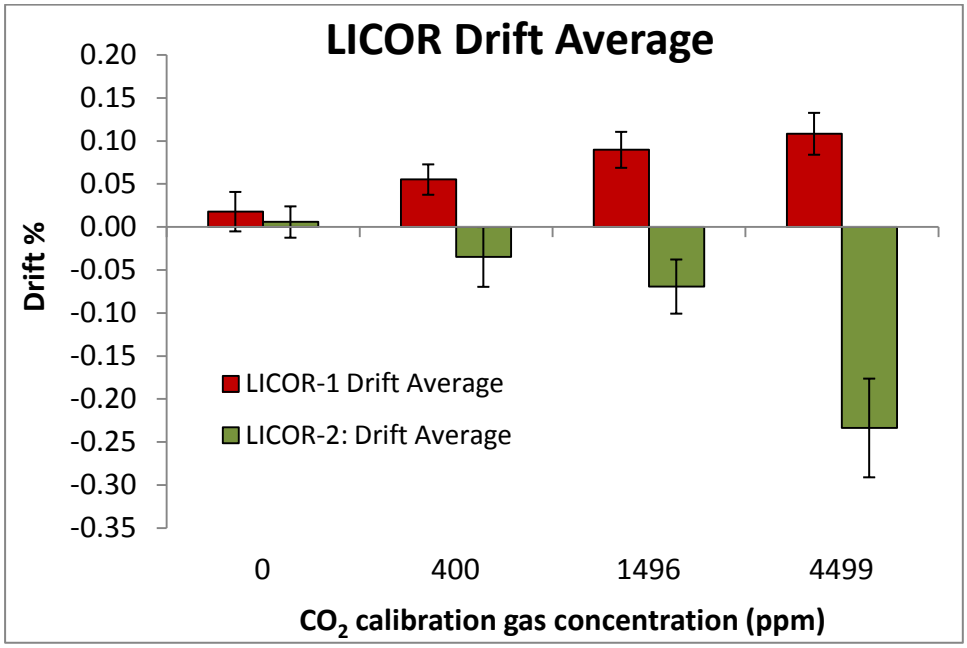


Figure 1. Drift data for LICOR-1 and LICOR-2.

The LI-820 Instruction manual is stating the following drift data:

- Zero drift: < 0.15 ppm/°C
- Span Drift at 370 ppm: <0.03%/°C
- Total Drift at 370 ppm: 0.4ppm/°C

Appendix K: Laboratory Report for Energetics in Air

August 14, 2012 Analytical Report for Service Request No: K1206334

Dennis Tabor
US Environmental Protection Agency (E-305-01)
Office of Research & Development National Risk Man
109 T.W. Alexander Drive
Research Traingel Park, NC 27711

RE: Explosive Residue

Dear Dennis:

Enclosed are the results of the samples submitted to our laboratory on June 30, 2012. For your reference, these analyses have been assigned our service request number K1206334.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.caslab.com. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please call if you have any questions. My extension is 3291. You may also contact me via Email at Ed.Wallace@alsglobal.com.

Respectfully submitted,

Columbia Analytical Services, Inc.

Ed Wallace

Ed Wallace
Project Manager

EW/dp

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Columbia Analytical Services™

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Columbia Analytical Services, Inc.
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Environmental www.caslab.com ▪ www.alsglobal.com

RIGHT SOLUTIONS RIGHT PARTNER

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

Columbia Analytical Services, Inc. - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Louisiana DHH	Not available	LA110003
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
New Mexico ED	http://www.nmenv.state.nm.us/dwb/Index.htm	-
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.caslab.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.caslab.com or at the accreditation bodies web site

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS ENVIRONMENTAL

Client:	US Environmental Protection Agency	**Service Request No.:**	K1206334
Project:	Nitroaromatics	**Date Received:**	06/30/12
Sample Matrix:	Filter		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Seventeen filter samples were received for analysis at ALS Environmental on 06/30/12. The samples were received in good condition. The samples were stored in a refrigerator at 4°C upon receipt at the laboratory.

Sample 'PS-OD-SVOC-062812' was received but not listed on the chain of custody form.

Sample 'PS-OD-SVOC-062312' was listed on the chain of custody form but not received.

Nitroaromatics and Nitramines by LC/MS/MS

Lab Control Sample Exceptions:
The recovery of a few analytes in the Duplicate Lab Control samples were outside the control limits listed in the results summary. The limits are default values temporarily in use until sufficient data points are generated to calculate statistical control limits. Based on the method and historic data, the recoveries observed were in the range expected for this procedure. No further corrective action was taken.

Elevated Detection Limits:
Due to the size and nature of the filter samples, more solvent than originally planned was necessary to properly extract the material. This resulted in an elevated Method Reporting Limit of 100 ng/sample.

No other anomalies associated with the analysis of these samples were observed.

Approved by EMW **Date** 8/17/12

Chain of Custody

Lab Work Order #: 1206334

Page 1 of 2

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

SVOC - RDX

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
						Requested Analyses										
PS-OD-SVOC - 061312	061312		Comp B Surface	Containment 6365		X	X	X								Glass tube Weight pre: 4.71g post: 5.26
PS-OD-SVOC 061412	061412 061512		Comp B 6 feet	8 first		X	X	X								Weight pre 4.70 post 7.75 First and second series
PS-OD-SVOC - 061512	061512		Comp B 6 feet	4 last		X	X	X								Weight pre 4.65 post 6.69 Third series
PS-OD-SVOC - 061612-01	061612		Comp B 3 feet	First series		X	X	X								Weight Pre: 4.72g Post: 9.94g Wilbur holder
PS-OD-SVOC - 061612-02	061612		Comp B 3 feet	Series #2		X	X	X								Weight Pre: 4.74g Post 8.85g Orville holder
PS-OD-SVOC - 061612-03	061612		Comp B 3 feet	Series #3		X	X	X								Weight Pre: 4.65g Post 6.96g Wilbur holder
PS-OD-SVOC - 061812-01	061812		Comp B 3 feet	First series		X	X	X								Weight: Pre: 4.72g Post: 5.82g Orville holder
PS-OD-SVOC - 061812-02	061812 061912		Wavhead 6 feet (1)	First series First series	061812 061912	X	X	X								Weight Pre: 4.67g Post: 5.18g Wilbur holder
PS-OD-SVOC - 061912	061912		Wavhead (3) 6 feet	Second third series		X	X	X								Weight: Pre 4.80g Post 5.61g Orville holder
PS-OD-SVOC - 062012	062012		Ambient	Dirty Ambient		X	X	X								Weight Pre 4.60g Post 4.66g Wilbur holder

Requested Analyses	
1	RDX
2	HMX
3	TNT
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	6/29/12						
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	6/30/12	920	[signature]				

Lab Work Order # 1C1206334

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

SVOC- RDX

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-SVOC-~~0211~~ 062112-01	062112		Warlead 6feet			X	X	X								Weight pre: 4.55 post: 5.01 First series
PS-OD-SVOC - 062112-02	062112		Warlead 3feet			X	X	X								Weight pre: 4.60 post: 7.47g Second series
PS-OD-SVOC- 062212	062212		V548 3feet			X	X	X								Weight pre 4.47g post 5.92g First and second series
PS-OD-SVOC- 062312	062312		V548 3feet													Weight pre: 4.57g post 4.84g Gravel Blower not ON
PS-OD-SVOC- 062512-01	062512		V548 3feet			X	X	X								Weight pre: 4.53 post 6.46g Gravel First series
PS-OD-SVOC 062512-02	062512		V548 3feet			X	X	X								Weight pre: 4.49g post 5.79g Gravel Second series
PS-OD-SVOC 062612-01	062612		V548 3feet			X	X	X								Weight pre: 4.55g post: 5.97 First and second series
						X	X	X								

Requested Analyses

1 RDX
2 HMX
3 TNT
4
5
6
7

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:
Shipping Tracking #
Specify Turnaround Requirements:
☐ Cooler packed with ice
☐ Cooler custody seal intact
Sample Receipt:
Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	6/29/12						
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	6/30/12	9:20	[signature]				

PC ED

Cooler Receipt and Preservation Form

Client / Project: Tooele Army Depot Service Request K12 06334

Received: 6/30/12 Opened: 6/30/12 By: RST Unloaded: 6/30/12 By: RST

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other*_____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where?_____

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Cooler Temp °C	Temp Blank °C	Thermometer ID	Cooler/COC ID NA	Tracking Number NA	Filed
1.8	2.4	289		1Z A5E76244 9575 0206	

7. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
8. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
10. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
11. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
12. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
13. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
14. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
15. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: Rec'd 1 filter not listed on COC, ID: BS-OD-SVOC-062812 "Ambient Air" Weight Pre: 4.52g Post: 5.08g

Did not receive: PS-OD-SVOC-062312 "Ground blower not on" Weight Pre: 4.57g Post: 4.84g.

Nitroaromatics and Nitramines

Organics Analysis:
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Summary Package

Sample and QC Results

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name	Lab Code	Date Collected	Date Received
PS-OD-SVOC-061312	K1206334-001	06/13/2012	06/30/2012
PS-OD-SVOC-061412	K1206334-002	06/14/2012	06/30/2012
PS-OD-SVOC-061512	K1206334-003	06/15/2012	06/30/2012
PS-OD-SVOC-061612-01	K1206334-004	06/16/2012	06/30/2012
PS-OD-SVOC-061612-02	K1206334-005	06/16/2012	06/30/2012
PS-OD-SVOC-061612-03	K1206334-006	06/16/2012	06/30/2012
PS-OD-SVOC-061812-01	K1206334-007	06/18/2012	06/30/2012
PS-OD-SVOC-061812-02	K1206334-008	06/18/2012	06/30/2012
PS-OD-SVOC-061912	K1206334-009	06/19/2012	06/30/2012
PS-OD-SVOC-062012	K1206334-010	06/20/2012	06/30/2012
PS-OD-SVOC-062112-01	K1206334-011	06/21/2012	06/30/2012
PS-OD-SVOC-062112-02	K1206334-012	06/21/2012	06/30/2012
PS-OD-SVOC-062212	K1206334-013	06/22/2012	06/30/2012
PS-OD-SVOC-062512-01	K1206334-014	06/25/2012	06/30/2012
PS-OD-SVOC-062512-02	K1206334-015	06/25/2012	06/30/2012
PS-OD-SVOC-062612	K1206334-016	06/26/2012	06/30/2012
PS-OD-SVOC-062812	K1206334-017	06/28/2012	06/30/2012

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the case narrative. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Doug Haderly Name: Doug Haderly

Date: 8/13/12 Title: Scientist

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Cover Page

SuperSet Reference: 12-0000220396 rev 00

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/13/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061312	**Units:**	ng/Sample
Lab Code:	K1206334-001	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**62**	J	100	25	1	7/ 6/12	7/30/12 19:08	161950	302794	
RDX	**330**		100	18	1	7/ 6/12	7/30/12 19:08	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 19:08	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 19:08	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**330**		100	11	1	7/ 6/12	7/30/12 19:08	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 19:08	161950	302794	
2-Amino-4,6-dinitrotoluene	**13**	J	100	9.0	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,4-Dinitrotoluene	**130**		120	120	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 19:08	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 19:08	161950	302794	
PETN	**33**	J	100	20	1	7/ 6/12	7/30/12 19:08	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	101	70-130	7/30/12 19:08	
1,3-Dinitrobenzene-C13	114	70-130	7/30/12 19:08	

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/14/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061412	**Units:**	ng/Sample
Lab Code:	K1206334-002	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**74**	J	100	25	1	7/ 6/12	7/30/12 19:35	161950	302794	
RDX	**180**		100	18	1	7/ 6/12	7/30/12 19:35	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 19:35	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 19:35	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**74**	J	100	11	1	7/ 6/12	7/30/12 19:35	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 19:35	161950	302794	
2-Amino-4,6-dinitrotoluene	**14**	J	100	9.0	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,4-Dinitrotoluene	**200**		120	120	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 19:35	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 19:35	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 19:35	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	95	70-130	7/30/12 19:35	
1,3-Dinitrobenzene-C13	107	70-130	7/30/12 19:35	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/15/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061512	**Units:**	ng/Sample
Lab Code:	K1206334-003	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**26**	J	100	25	1	7/ 6/12	7/30/12 20:01	161950	302794	
RDX	**61**	J	100	18	1	7/ 6/12	7/30/12 20:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**11**	J	100	11	1	7/ 6/12	7/30/12 20:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:01	161950	302794	
2-Amino-4,6-dinitrotoluene	**16**	J	100	9.0	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,4-Dinitrotoluene	**320**		120	120	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:01	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 20:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	95	70-130	7/30/12 20:01	
1,3-Dinitrobenzene-C13	111	70-130	7/30/12 20:01	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-01	**Units:**	ng/Sample
Lab Code:	K1206334-004	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**27**	J	100	25	1	7/ 6/12	7/30/12 20:28	161950	302794	
RDX	**86**	J	100	18	1	7/ 6/12	7/30/12 20:28	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:28	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:28	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**16**	J	100	11	1	7/ 6/12	7/30/12 20:28	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:28	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,4-Dinitrotoluene	**560**		120	120	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:28	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:28	161950	302794	
PETN	**26**	J	100	20	1	7/ 6/12	7/30/12 20:28	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	88	70-130	7/30/12 20:28	
1,3-Dinitrobenzene-C13	101	70-130	7/30/12 20:28	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-02	**Units:**	ng/Sample
Lab Code:	K1206334-005	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/30/12 20:54	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 20:54	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:54	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:54	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 20:54	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:54	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,4-Dinitrotoluene	**300**		120	120	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:54	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:54	161950	302794	
PETN	**27**	J	100	20	1	7/ 6/12	7/30/12 20:54	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	90	70-130	7/30/12 20:54	
1,3-Dinitrobenzene-C13	103	70-130	7/30/12 20:54	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-03	**Units:**	ng/Sample
Lab Code:	K1206334-006	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**45**	J	100	25	1	7/ 6/12	7/30/12 21:21	161950	302794	
RDX	**55**	J	100	18	1	7/ 6/12	7/30/12 21:21	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 21:21	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 21:21	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 21:21	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 21:21	161950	302794	
2-Amino-4,6-dinitrotoluene	**11**	J	100	9.0	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,4-Dinitrotoluene	**490**		120	120	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 21:21	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 21:21	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 21:21	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	88	70-130	7/30/12 21:21	
1,3-Dinitrobenzene-C13	105	70-130	7/30/12 21:21	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061812-01	**Units:**	ng/Sample
Lab Code:	K1206334-007	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**32**	J	100	25	1	7/ 6/12	7/30/12 21:48	161950	302794	
RDX	**110**		100	18	1	7/ 6/12	7/30/12 21:48	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 21:48	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 21:48	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**89**	J	100	11	1	7/ 6/12	7/30/12 21:48	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 21:48	161950	302794	
2-Amino-4,6-dinitrotoluene	**9.0**	J	100	9.0	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 21:48	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 21:48	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 21:48	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	84	70-130	7/30/12 21:48	
1,3-Dinitrobenzene-C13	108	70-130	7/30/12 21:48	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061812-02	**Units:**	ng/Sample
Lab Code:	K1206334-008	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/30/12 22:14	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 22:14	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 22:14	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 22:14	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 22:14	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 22:14	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 22:14	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 22:14	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 22:14	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	82	70-130	7/30/12 22:14	
1,3-Dinitrobenzene-C13	96	70-130	7/30/12 22:14	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/19/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061912	**Units:**	ng/Sample
Lab Code:	K1206334-009	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**31**	J	100	25	1	7/ 6/12	7/30/12 22:41	161950	302794	
RDX	**34**	J	100	18	1	7/ 6/12	7/30/12 22:41	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 22:41	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 22:41	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 22:41	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 22:41	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 22:41	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 22:41	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 22:41	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	93	70-130	7/30/12 22:41	
1,3-Dinitrobenzene-C13	105	70-130	7/30/12 22:41	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/20/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062012	**Units:**	ng/Sample
Lab Code:	K1206334-010	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**35**	J	100	25	1	7/ 6/12	7/30/12 23:08	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 23:08	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 23:08	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 23:08	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 23:08	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 23:08	161950	302794	
2-Amino-4,6-dinitrotoluene	**11**	J	100	9.0	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 23:08	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 23:08	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 23:08	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	89	70-130	7/30/12 23:08	
1,3-Dinitrobenzene-C13	104	70-130	7/30/12 23:08	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/21/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062112-01	**Units:**	ng/Sample
Lab Code:	K1206334-011	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/31/12 00:01	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 00:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:01	161950	302794	
2-Amino-4,6-dinitrotoluene	**10**	J	100	9.0	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:01	161950	302794	
3,5-Dinitroaniline	**13**	J	100	12	1	7/ 6/12	7/31/12 00:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 00:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	87	70-130	7/31/12 00:01	
1,3-Dinitrobenzene-C13	100	70-130	7/31/12 00:01	

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Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/21/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062112-02	**Units:**	ng/Sample
Lab Code:	K1206334-012	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**31**	J	100	25	1	7/ 6/12	7/31/12 00:28	161950	302794	
RDX	**30**	J	100	18	1	7/ 6/12	7/31/12 00:28	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:28	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:28	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:28	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:28	161950	302794	
2-Amino-4,6-dinitrotoluene	**16**	J	100	9.0	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:28	161950	302794	
3,5-Dinitroaniline	**13**	J	100	12	1	7/ 6/12	7/31/12 00:28	161950	302794	
PETN	**31**	J	100	20	1	7/ 6/12	7/31/12 00:28	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	89	70-130	7/31/12 00:28	
1,3-Dinitrobenzene-C13	104	70-130	7/31/12 00:28	

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/22/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062212	**Units:**	ng/Sample
Lab Code:	K1206334-013	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**1700**		100	25	1	7/ 6/12	7/31/12 00:54	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 00:54	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:54	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:54	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:54	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:54	161950	302794	
2-Amino-4,6-dinitrotoluene	**12**	J	100	9.0	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:54	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 00:54	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 00:54	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	81	70-130	7/31/12 00:54	
1,3-Dinitrobenzene-C13	93	70-130	7/31/12 00:54	

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/25/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062512-01	**Units:**	ng/Sample
Lab Code:	K1206334-014	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**2000**		100	25	1	7/ 6/12	7/31/12 01:21	161950	302794	
RDX	**19**	J	100	18	1	7/ 6/12	7/31/12 01:21	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 01:21	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 01:21	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 01:21	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 01:21	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 01:21	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 01:21	161950	302794	
PETN	**85**	J	100	20	1	7/ 6/12	7/31/12 01:21	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	74	70-130	7/31/12 01:21	
1,3-Dinitrobenzene-C13	86	70-130	7/31/12 01:21	

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/25/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062512-02	**Units:**	ng/Sample
Lab Code:	K1206334-015	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**210**		100	25	1	7/ 6/12	7/31/12 01:48	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 01:48	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 01:48	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 01:48	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**45**	J	100	11	1	7/ 6/12	7/31/12 01:48	161950	302794	
4-Amino-2,6-dinitrotoluene	**24**	J	100	16	1	7/ 6/12	7/31/12 01:48	161950	302794	
2-Amino-4,6-dinitrotoluene	**17**	J	100	9.0	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 01:48	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 01:48	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 01:48	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	85	70-130	7/31/12 01:48	
1,3-Dinitrobenzene-C13	105	70-130	7/31/12 01:48	

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/26/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062612	**Units:**	ng/Sample
Lab Code:	K1206334-016	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**2200**		100	25	1	7/ 6/12	7/31/12 02:14	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 02:14	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 02:14	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 02:14	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 02:14	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 02:14	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 02:14	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 02:14	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 02:14	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	86	70-130	7/31/12 02:14	
1,3-Dinitrobenzene-C13	100	70-130	7/31/12 02:14	

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062812	**Units:**	ng/Sample
Lab Code:	K1206334-017	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**36**	J	100	25	1	7/ 6/12	7/31/12 02:41	161950	302794	
RDX	**35**	J	100	18	1	7/ 6/12	7/31/12 02:41	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 02:41	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 02:41	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**60**	J	100	11	1	7/ 6/12	7/31/12 02:41	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 02:41	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,4-Dinitrotoluene	**540**		120	120	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 02:41	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 02:41	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 02:41	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	83	70-130	7/31/12 02:41	
1,3-Dinitrobenzene-C13	91	70-130	7/31/12 02:41	

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Filter	**Date Received:**	NA
Sample Name:	Method Blank	**Units:**	ng/Sample
Lab Code:	KQ1207704-03	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/31/12 04:01	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 04:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 04:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 04:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 04:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 04:01	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 04:01	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 04:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 04:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	73	70-130	7/31/12 04:01	
1,3-Dinitrobenzene-C13	91	70-130	7/31/12 04:01	

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Filter
Service Request: K1206334

Surrogate Recovery Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP
Units: Percent

Sample Name	Lab Code	Sur1	Sur2
PS-OD-SVOC-061312	K1206334-001	101	114
PS-OD-SVOC-061412	K1206334-002	95	107
PS-OD-SVOC-061512	K1206334-003	95	111
PS-OD-SVOC-061612-01	K1206334-004	88	101
PS-OD-SVOC-061612-02	K1206334-005	90	103
PS-OD-SVOC-061612-03	K1206334-006	88	105
PS-OD-SVOC-061812-01	K1206334-007	84	108
PS-OD-SVOC-061812-02	K1206334-008	82	96
PS-OD-SVOC-061912	K1206334-009	93	105
PS-OD-SVOC-062012	K1206334-010	89	104
PS-OD-SVOC-062112-01	K1206334-011	87	100
PS-OD-SVOC-062112-02	K1206334-012	89	104
PS-OD-SVOC-062212	K1206334-013	81	93
PS-OD-SVOC-062512-01	K1206334-014	74	86
PS-OD-SVOC-062512-02	K1206334-015	85	105
PS-OD-SVOC-062612	K1206334-016	86	100
PS-OD-SVOC-062812	K1206334-017	83	91
Method Blank	KQ1207704-03	73	91
Lab Control Sample	KQ1207704-01	84	96
Duplicate Lab Control Sample	KQ1207704-02	78	94

Surrogate Recovery Control Limits (%)

Sur1	= C13-HMX	70 - 130
Sur2	= 1,3-Dinitrobenzene-C13	70 - 130

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Filter

Service Request: K1206334
Date Analyzed: 7/31/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Units: ng/Sample
Basis: As Received

Extraction Lot: 161950

	Lab Control Sample KQ1207704-01			Duplicate Lab Control Sample KQ1207704-02						
Analyte Name	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**	**RPD Limit**
HMX	3820	5000	76	3470	5000	69	*	70 - 130	10	40
RDX	3700	5000	74	3410	5000	68	*	70 - 130	8	40
1,3,5-Trinitrobenzene	4370	5000	87	3870	5000	77		70 - 130	12	40
1,3-Dinitrobenzene	5070	5000	101	4840	5000	97		70 - 130	5	40
Tetryl	3560	5000	71	3260	5000	65	*	70 - 130	9	40
2,4,6-Trinitrotoluene (TNT)	4380	5000	88	4180	5000	84		70 - 130	5	40
4-Amino-2,6-dinitrotoluene	4350	5000	87	4220	5000	84		70 - 130	3	40
2-Amino-4,6-dinitrotoluene	4170	5000	83	4010	5000	80		70 - 130	4	40
2,4-Dinitrotoluene	4840	5000	97	4240	5000	85		70 - 130	13	40
2,6-Dinitrotoluene	5710	5000	114	4970	5000	99		70 - 130	14	40
3,5-Dinitroaniline	4280	5000	86	4040	5000	81		70 - 130	6	40
PETN	4400	5000	88	4060	5000	81		70 - 130	8	40

Results flagged with an asterisk (*) indicate values outside control criteria.
Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 04:01
Sample Matrix:	Filter	**Date Extracted:**	7/6/12

Method Blank Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Method Blank	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207704-03	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Method Blank applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
PS-OD-SVOC-061312	K1206334-001	073012\Spl.wiff	7/30/12 19:08
PS-OD-SVOC-061412	K1206334-002	073012\Spl.wiff	7/30/12 19:35
PS-OD-SVOC-061512	K1206334-003	073012\Spl.wiff	7/30/12 20:01
PS-OD-SVOC-061612-01	K1206334-004	073012\Spl.wiff	7/30/12 20:28
PS-OD-SVOC-061612-02	K1206334-005	073012\Spl.wiff	7/30/12 20:54
PS-OD-SVOC-061612-03	K1206334-006	073012\Spl.wiff	7/30/12 21:21
PS-OD-SVOC-061812-01	K1206334-007	073012\Spl.wiff	7/30/12 21:48
PS-OD-SVOC-061812-02	K1206334-008	073012\Spl.wiff	7/30/12 22:14
PS-OD-SVOC-061912	K1206334-009	073012\Spl.wiff	7/30/12 22:41
PS-OD-SVOC-062012	K1206334-010	073012\Spl.wiff	7/30/12 23:08
PS-OD-SVOC-062112-01	K1206334-011	073012\Spl.wiff	7/31/12 00:01
PS-OD-SVOC-062112-02	K1206334-012	073012\Spl.wiff	7/31/12 00:28
PS-OD-SVOC-062212	K1206334-013	073012\Spl.wiff	7/31/12 00:54
PS-OD-SVOC-062512-01	K1206334-014	073012\Spl.wiff	7/31/12 01:21
PS-OD-SVOC-062512-02	K1206334-015	073012\Spl.wiff	7/31/12 01:48
PS-OD-SVOC-062612	K1206334-016	073012\Spl.wiff	7/31/12 02:14
PS-OD-SVOC-062812	K1206334-017	073012\Spl.wiff	7/31/12 02:41
Lab Control Sample	KQ1207704-01	073012\Spl.wiff	7/31/12 03:08
Duplicate Lab Control Sample	KQ1207704-02	073012\Spl.wiff	7/31/12 03:34

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 03:08
Sample Matrix:	Filter	**Date Extracted:**	7/6/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Lab Control Sample	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207704-01	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Lab Control Sample applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
PS-OD-SVOC-061312	K1206334-001	073012\Spl.wiff	7/30/12 19:08
PS-OD-SVOC-061412	K1206334-002	073012\Spl.wiff	7/30/12 19:35
PS-OD-SVOC-061512	K1206334-003	073012\Spl.wiff	7/30/12 20:01
PS-OD-SVOC-061612-01	K1206334-004	073012\Spl.wiff	7/30/12 20:28
PS-OD-SVOC-061612-02	K1206334-005	073012\Spl.wiff	7/30/12 20:54
PS-OD-SVOC-061612-03	K1206334-006	073012\Spl.wiff	7/30/12 21:21
PS-OD-SVOC-061812-01	K1206334-007	073012\Spl.wiff	7/30/12 21:48
PS-OD-SVOC-061812-02	K1206334-008	073012\Spl.wiff	7/30/12 22:14
PS-OD-SVOC-061912	K1206334-009	073012\Spl.wiff	7/30/12 22:41
PS-OD-SVOC-062012	K1206334-010	073012\Spl.wiff	7/30/12 23:08
PS-OD-SVOC-062112-01	K1206334-011	073012\Spl.wiff	7/31/12 00:01
PS-OD-SVOC-062112-02	K1206334-012	073012\Spl.wiff	7/31/12 00:28
PS-OD-SVOC-062212	K1206334-013	073012\Spl.wiff	7/31/12 00:54
PS-OD-SVOC-062512-01	K1206334-014	073012\Spl.wiff	7/31/12 01:21
PS-OD-SVOC-062512-02	K1206334-015	073012\Spl.wiff	7/31/12 01:48
PS-OD-SVOC-062612	K1206334-016	073012\Spl.wiff	7/31/12 02:14
PS-OD-SVOC-062812	K1206334-017	073012\Spl.wiff	7/31/12 02:41
Duplicate Lab Control Sample	KQ1207704-02	073012\Spl.wiff	7/31/12 03:34
Method Blank	KQ1207704-03	073012\Spl.wiff	7/31/12 04:01

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date	#	File Location	Acquisition Date
02	073012\Calib.wiff	7/30/12 14:41	03	073012\Calib.wiff	7/30/12 15:08
04	073012\Calib.wiff	7/30/12 15:35	05	073012\Calib.wiff	7/30/12 16:01
06	073012\Calib.wiff	7/30/12 16:28	07	073012\Calib.wiff	7/30/12 16:54
08	073012\Calib.wiff	7/30/12 17:21			

Analyte

HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	9.404E4	03	2.00	9.609E4	04	5.00	9.957E4	05	10.0	1.112E5
06	50.0	1.078E5	07	100.	1.100E5	08	200.	1.127E5			

RDX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.985E4	03	2.00	2.908E4	04	5.00	3.004E4	05	10.0	3.156E4
06	50.0	3.169E4	07	100.	3.084E4	08	200.	3.290E4			

1,3,5-Trinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.481E5	03	2.00	1.595E5	04	5.00	1.760E5	05	10.0	1.810E5
06	50.0	1.817E5	07	100.	1.611E5	08	200.	1.714E5			

1,3-Dinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.706E4	03	2.00	1.905E4	04	5.00	1.746E4	05	10.0	1.751E4
06	50.0	1.708E4	07	100.	1.799E4	08	200.	1.907E4			

Tetryl

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.763E4	03	2.00	2.899E4	04	5.00	2.936E4	05	10.0	3.046E4
06	50.0	2.735E4	07	100.	2.946E4	08	200.	3.037E4			

2,4,6-Trinitrotoluene (TNT)

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.992E5	03	2.00	2.092E5	04	5.00	2.237E5	05	10.0	2.148E5
06	50.0	2.052E5	07	100.	2.040E5	08	200.	2.117E5			

4-Amino-2,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.915E5	03	2.00	2.980E5	04	5.00	3.193E5	05	10.0	3.262E5
06	50.0	3.068E5	07	100.	2.846E5	08	200.	2.783E5			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

Analyte

2-Amino-4,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	7.461E5	03	2.00	7.928E5	04	5.00	8.506E5	05	10.0	8.428E5
06	50.0	7.692E5	07	100.	6.518E5	08	200.	5.264E5			

2,4-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	605.0	03	2.00	658.5	04	5.00	739.5	05	10.0	723.6
06	50.0	805.2	07	100.	751.6	08	200.	841.6			

2,6-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1,363	03	2.00	1,273	04	5.00	1,660	05	10.0	1,684
06	50.0	1,790	07	100.	1,647	08	200.	2,073			

3,5-Dinitroaniline

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.309E5	03	2.00	1.400E5	04	5.00	1.435E5	05	10.0	1.510E5
06	50.0	1.481E5	07	100.	1.438E5	08	200.	1.442E5			

PETN

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	8,939	03	2.00	8,985	04	5.00	9,398	05	10.0	9,423
06	50.0	9,636	07	100.	9,745	08	200.	1.061E4			

C13-HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	3.753E4	03	2.00	3.852E4	04	5.00	3.957E4	05	10.0	4.467E4
06	50.0	4.414E4	07	100.	4.577E4	08	200.	4.968E4			

1,3-Dinitrobenzene-C13

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.720E4	03	2.00	2.944E4	04	5.00	2.628E4	05	10.0	2.853E4
06	50.0	2.809E4	07	100.	2.835E4	08	200.	3.124E4			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

		Calibration Evaluation					RRF Evaluation		
Analyte Name	**Compound Type**	**Fit Type**	**Eval.**	**Eval. Result**	**Q**	**Control Criteria**	**Average RRF**	**Q**	**Minimum RRF**
HMX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
RDX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
1,3,5-Trinitrobenzene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
1,3-Dinitrobenzene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
Tetryl	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2,4,6-Trinitrotoluene (TNT)	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
4-Amino-2,6-dinitrotoluene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2-Amino-4,6-dinitrotoluene	TRG	Quadratic	COD	0.999		≥ 0.990	NA		
2,4-Dinitrotoluene	TRG	Linear	R2	0.997		≥ 0.990	NA		
2,6-Dinitrotoluene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
3,5-Dinitroaniline	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
PETN	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
C13-HMX	SURR	Quadratic	COD	1.000		≥ 0.990	NA		
1,3-Dinitrobenzene-C13	SURR	Quadratic	COD	1.000		≥ 0.990	NA		

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Verfication Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date
40	073012\Calib.wiff	7/30/12 18:41

Analyte Name	Expected	Result	Average RF	SSV RF	%D	Criteria	Curve Fit
HMX	100.	112.780	1.045E5	1.244E5	12.78	±30	Quadratic
RDX	100.	109.539	3.085E4	3.469E4	9.54	±30	Quadratic
1,3,5-Trinitrobenzene	100.	113.984	1.684E5	1.945E5	13.98	±30	Quadratic
1,3-Dinitrobenzene	100.	125.197	1.789E4	2.279E4	25.20	±30	Quadratic
Tetryl	100.	121.625	2.909E4	3.573E4	21.63	±30	Quadratic
2,4,6-Trinitrotoluene (TNT)	100.	122.828	2.097E5	2.554E5	22.83	±30	Quadratic
4-Amino-2,6-dinitrotoluene	100.	114.681	3.007E5	3.331E5	14.68	±30	Quadratic
2-Amino-4,6-dinitrotoluene	100.	118.245	7.400E5	7.645E5	18.24	±30	Quadratic
2,4-Dinitrotoluene	100.	112.377	732.1	909.2	12.38	±30	Linear
2,6-Dinitrotoluene	100.	117.310	1,641	2,146	17.31	±30	Quadratic
3,5-Dinitroaniline	100.	112.234	1.431E5	1.633E5	12.23	±30	Quadratic
PETN	100.	111.426	9,534	1.109E4	11.43	±30	Quadratic
C13-HMX	100.	105.792	4.284E4	4.890E4	5.79	±30	Quadratic
1,3-Dinitrobenzene-C13	100.	116.671	2.845E4	3.410E4	16.67	±30	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	113	NA	NA	NA	12.8	± 30 %	Quadratic
RDX	100	110	NA	NA	NA	9.5	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	114	NA	NA	NA	14.0	± 30 %	Quadratic
1,3-Dinitrobenzene	100	125	NA	NA	NA	25.2	± 30 %	Quadratic
Tetryl	100	122	NA	NA	NA	21.6	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	123	NA	NA	NA	22.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	115	NA	NA	NA	14.7	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	118	NA	NA	NA	18.2	± 30 %	Quadratic
2,4-Dinitrotoluene	100	112	NA	NA	NA	12.4	± 30 %	Linear
2,6-Dinitrotoluene	100	117	NA	NA	NA	17.3	± 30 %	Quadratic
3,5-Dinitroaniline	100	112	NA	NA	NA	12.2	± 30 %	Quadratic
C13-HMX	100	106	NA	NA	NA	5.8	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	117	NA	NA	NA	16.7	± 30 %	Quadratic
PETN	100	111	NA	NA	NA	11.4	± 30 %	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	95.3	NA	NA	NA	-4.7	± 30 %	Quadratic
RDX	100	86.6	NA	NA	NA	-13.4	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	99.1	NA	NA	NA	-0.9	± 30 %	Quadratic
1,3-Dinitrobenzene	100	106	NA	NA	NA	6.2	± 30 %	Quadratic
Tetryl	100	96.9	NA	NA	NA	-3.1	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	104	NA	NA	NA	3.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	99.5	NA	NA	NA	-0.5	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	100	NA	NA	NA	0.0	± 30 %	Quadratic
2,4-Dinitrotoluene	100	83.1	NA	NA	NA	-16.9	± 30 %	Linear
2,6-Dinitrotoluene	100	115	NA	NA	NA	15.0	± 30 %	Quadratic
3,5-Dinitroaniline	100	99.0	NA	NA	NA	-1.0	± 30 %	Quadratic
C13-HMX	100	91.7	NA	NA	NA	-8.3	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	103	NA	NA	NA	3.0	± 30 %	Quadratic
PETN	100	95.9	NA	NA	NA	-4.1	± 30 %	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334

Analysis Run Log
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

Analysis Lot: 302794
Instrument ID: K-LCMS-02

Raw Data File	Sample Name	Lab Code	Date Analyzed	Time Analyzed	Q
Calib.wiff	Continuing Cal. Verification	KQ1208851-01	7/30/12	18:41	
Spl.wiff	PS-OD-SVOC-061312	K1206334-001	7/30/12	19:08	
Spl.wiff	PS-OD-SVOC-061412	K1206334-002	7/30/12	19:35	
Spl.wiff	PS-OD-SVOC-061512	K1206334-003	7/30/12	20:01	
Spl.wiff	PS-OD-SVOC-061612-01	K1206334-004	7/30/12	20:28	
Spl.wiff	PS-OD-SVOC-061612-02	K1206334-005	7/30/12	20:54	
Spl.wiff	PS-OD-SVOC-061612-03	K1206334-006	7/30/12	21:21	
Spl.wiff	PS-OD-SVOC-061812-01	K1206334-007	7/30/12	21:48	
Spl.wiff	PS-OD-SVOC-061812-02	K1206334-008	7/30/12	22:14	
Spl.wiff	PS-OD-SVOC-061912	K1206334-009	7/30/12	22:41	
Spl.wiff	PS-OD-SVOC-062012	K1206334-010	7/30/12	23:08	
Calib.wiff	Continuing Cal. Verification	KQ1208851-02	7/30/12	23:34	
Spl.wiff	PS-OD-SVOC-062112-01	K1206334-011	7/31/12	00:01	
Spl.wiff	PS-OD-SVOC-062112-02	K1206334-012	7/31/12	00:28	
Spl.wiff	PS-OD-SVOC-062212	K1206334-013	7/31/12	00:54	
Spl.wiff	PS-OD-SVOC-062512-01	K1206334-014	7/31/12	01:21	
Spl.wiff	PS-OD-SVOC-062512-02	K1206334-015	7/31/12	01:48	
Spl.wiff	PS-OD-SVOC-062612	K1206334-016	7/31/12	02:14	
Spl.wiff	PS-OD-SVOC-062812	K1206334-017	7/31/12	02:41	
Spl.wiff	Lab Control Sample	KQ1207704-01	7/31/12	03:08	
Spl.wiff	Duplicate Lab Control Sample	KQ1207704-02	7/31/12	03:34	
Spl.wiff	Method Blank	KQ1207704-03	7/31/12	04:01	
Calib.wiff	Continuing Cal. Verification	KQ1208851-03	7/31/12	04:28	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	04:54	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	05:21	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	05:48	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	06:14	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	06:41	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	07:08	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	07:34	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	08:01	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	08:28	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	08:54	
Calib.wiff	Continuing Cal. Verification	KQ1208851-04	7/31/12	09:21	

Results flagged with an asterisk (*) indicate the holding time was exceeded for the analysis

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Prep Summary Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Filter

Service Request: K1206334

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Prep Method: CAS SOP
Analytical Method: CAS SOP

Extraction Lot: 161950

Sample Name	Lab Code	Date Collected	Date Received	Sample Amount	Final Amount	Percent Solids
PS-OD-SVOC-061312	K1206334-001	6/13/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061412	K1206334-002	6/14/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061512	K1206334-003	6/15/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061612-01	K1206334-004	6/16/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061612-02	K1206334-005	6/16/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061612-03	K1206334-006	6/16/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061812-01	K1206334-007	6/18/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061812-02	K1206334-008	6/18/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-061912	K1206334-009	6/19/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062012	K1206334-010	6/20/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062112-01	K1206334-011	6/21/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062112-02	K1206334-012	6/21/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062212	K1206334-013	6/22/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062512-01	K1206334-014	6/25/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062512-02	K1206334-015	6/25/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062612	K1206334-016	6/26/12	6/30/12	1.0000 each	100 mL	
PS-OD-SVOC-062812	K1206334-017	6/28/12	6/30/12	1.0000 each	100 mL	
Method Blank	KQ1207704-03			1.0000 each	100 mL	
Lab Control Sample	KQ1207704-01			1.0000 each	100 mL	
Duplicate Lab Control Sample	KQ1207704-02			1.0000 each	100 mL	

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

QC Reports

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Filter

Service Request: K1206334

Surrogate Recovery Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Units: Percent

Sample Name	Lab Code	Sur1	Sur2
PS-OD-SVOC-061312	K1206334-001	101	114
PS-OD-SVOC-061412	K1206334-002	95	107
PS-OD-SVOC-061512	K1206334-003	95	111
PS-OD-SVOC-061612-01	K1206334-004	88	101
PS-OD-SVOC-061612-02	K1206334-005	90	103
PS-OD-SVOC-061612-03	K1206334-006	88	105
PS-OD-SVOC-061812-01	K1206334-007	84	108
PS-OD-SVOC-061812-02	K1206334-008	82	96
PS-OD-SVOC-061912	K1206334-009	93	105
PS-OD-SVOC-062012	K1206334-010	89	104
PS-OD-SVOC-062112-01	K1206334-011	87	100
PS-OD-SVOC-062112-02	K1206334-012	89	104
PS-OD-SVOC-062212	K1206334-013	81	93
PS-OD-SVOC-062512-01	K1206334-014	74	86
PS-OD-SVOC-062512-02	K1206334-015	85	105
PS-OD-SVOC-062612	K1206334-016	86	100
PS-OD-SVOC-062812	K1206334-017	83	91
Method Blank	KQ1207704-03	73	91
Lab Control Sample	KQ1207704-01	84	96
Duplicate Lab Control Sample	KQ1207704-02	78	94

Surrogate Recovery Control Limits (%)

Sur1	= C13-HMX	70 - 130
Sur2	= 1,3-Dinitrobenzene-C13	70 - 130

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Filter

Service Request: K1206334
Date Analyzed: 7/31/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Units: ng/Sample
Basis: As Received

Extraction Lot: 161950

	Lab Control Sample KQ1207704-01			Duplicate Lab Control Sample KQ1207704-02						
Analyte Name	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**	**RPD Limit**
HMX	3820	5000	76	3470	5000	69	*	70 - 130	10	40
RDX	3700	5000	74	3410	5000	68	*	70 - 130	8	40
1,3,5-Trinitrobenzene	4370	5000	87	3870	5000	77		70 - 130	12	40
1,3-Dinitrobenzene	5070	5000	101	4840	5000	97		70 - 130	5	40
Tetryl	3560	5000	71	3260	5000	65	*	70 - 130	9	40
2,4,6-Trinitrotoluene (TNT)	4380	5000	88	4180	5000	84		70 - 130	5	40
4-Amino-2,6-dinitrotoluene	4350	5000	87	4220	5000	84		70 - 130	3	40
2-Amino-4,6-dinitrotoluene	4170	5000	83	4010	5000	80		70 - 130	4	40
2,4-Dinitrotoluene	4840	5000	97	4240	5000	85		70 - 130	13	40
2,6-Dinitrotoluene	5710	5000	114	4970	5000	99		70 - 130	14	40
3,5-Dinitroaniline	4280	5000	86	4040	5000	81		70 - 130	6	40
PETN	4400	5000	88	4060	5000	81		70 - 130	8	40

Results flagged with an asterisk (*) indicate values outside control criteria.
Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 04:01
Sample Matrix:	Filter	**Date Extracted:**	7/6/12

Method Blank Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Method Blank	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207704-03	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Method Blank applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
PS-OD-SVOC-061312	K1206334-001	073012\Spl.wiff	7/30/12 19:08
PS-OD-SVOC-061412	K1206334-002	073012\Spl.wiff	7/30/12 19:35
PS-OD-SVOC-061512	K1206334-003	073012\Spl.wiff	7/30/12 20:01
PS-OD-SVOC-061612-01	K1206334-004	073012\Spl.wiff	7/30/12 20:28
PS-OD-SVOC-061612-02	K1206334-005	073012\Spl.wiff	7/30/12 20:54
PS-OD-SVOC-061612-03	K1206334-006	073012\Spl.wiff	7/30/12 21:21
PS-OD-SVOC-061812-01	K1206334-007	073012\Spl.wiff	7/30/12 21:48
PS-OD-SVOC-061812-02	K1206334-008	073012\Spl.wiff	7/30/12 22:14
PS-OD-SVOC-061912	K1206334-009	073012\Spl.wiff	7/30/12 22:41
PS-OD-SVOC-062012	K1206334-010	073012\Spl.wiff	7/30/12 23:08
PS-OD-SVOC-062112-01	K1206334-011	073012\Spl.wiff	7/31/12 00:01
PS-OD-SVOC-062112-02	K1206334-012	073012\Spl.wiff	7/31/12 00:28
PS-OD-SVOC-062212	K1206334-013	073012\Spl.wiff	7/31/12 00:54
PS-OD-SVOC-062512-01	K1206334-014	073012\Spl.wiff	7/31/12 01:21
PS-OD-SVOC-062512-02	K1206334-015	073012\Spl.wiff	7/31/12 01:48
PS-OD-SVOC-062612	K1206334-016	073012\Spl.wiff	7/31/12 02:14
PS-OD-SVOC-062812	K1206334-017	073012\Spl.wiff	7/31/12 02:41
Lab Control Sample	KQ1207704-01	073012\Spl.wiff	7/31/12 03:08
Duplicate Lab Control Sample	KQ1207704-02	073012\Spl.wiff	7/31/12 03:34

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 03:08
Sample Matrix:	Filter	**Date Extracted:**	7/6/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Lab Control Sample	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207704-01	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Lab Control Sample applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
PS-OD-SVOC-061312	K1206334-001	073012\Spl.wiff	7/30/12 19:08
PS-OD-SVOC-061412	K1206334-002	073012\Spl.wiff	7/30/12 19:35
PS-OD-SVOC-061512	K1206334-003	073012\Spl.wiff	7/30/12 20:01
PS-OD-SVOC-061612-01	K1206334-004	073012\Spl.wiff	7/30/12 20:28
PS-OD-SVOC-061612-02	K1206334-005	073012\Spl.wiff	7/30/12 20:54
PS-OD-SVOC-061612-03	K1206334-006	073012\Spl.wiff	7/30/12 21:21
PS-OD-SVOC-061812-01	K1206334-007	073012\Spl.wiff	7/30/12 21:48
PS-OD-SVOC-061812-02	K1206334-008	073012\Spl.wiff	7/30/12 22:14
PS-OD-SVOC-061912	K1206334-009	073012\Spl.wiff	7/30/12 22:41
PS-OD-SVOC-062012	K1206334-010	073012\Spl.wiff	7/30/12 23:08
PS-OD-SVOC-062112-01	K1206334-011	073012\Spl.wiff	7/31/12 00:01
PS-OD-SVOC-062112-02	K1206334-012	073012\Spl.wiff	7/31/12 00:28
PS-OD-SVOC-062212	K1206334-013	073012\Spl.wiff	7/31/12 00:54
PS-OD-SVOC-062512-01	K1206334-014	073012\Spl.wiff	7/31/12 01:21
PS-OD-SVOC-062512-02	K1206334-015	073012\Spl.wiff	7/31/12 01:48
PS-OD-SVOC-062612	K1206334-016	073012\Spl.wiff	7/31/12 02:14
PS-OD-SVOC-062812	K1206334-017	073012\Spl.wiff	7/31/12 02:41
Duplicate Lab Control Sample	KQ1207704-02	073012\Spl.wiff	7/31/12 03:34
Method Blank	KQ1207704-03	073012\Spl.wiff	7/31/12 04:01

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Raw Data

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/13/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061312	**Units:**	ng/Sample
Lab Code:	K1206334-001	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**62**	J	100	25	1	7/ 6/12	7/30/12 19:08	161950	302794	
RDX	**330**		100	18	1	7/ 6/12	7/30/12 19:08	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 19:08	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 19:08	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**330**		100	11	1	7/ 6/12	7/30/12 19:08	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 19:08	161950	302794	
2-Amino-4,6-dinitrotoluene	**13**	J	100	9.0	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,4-Dinitrotoluene	**130**		120	120	1	7/ 6/12	7/30/12 19:08	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 19:08	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 19:08	161950	302794	
PETN	**33**	J	100	20	1	7/ 6/12	7/30/12 19:08	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	101	70-130	7/30/12 19:08	
1,3-Dinitrobenzene-C13	114	70-130	7/30/12 19:08	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

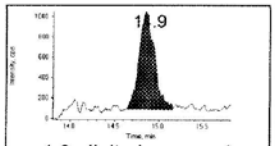
Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-001	**Injection Volume**	100
Acquisition Date	7/30/2012 7:08:19 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	11	**Weight to Volume**	0.00

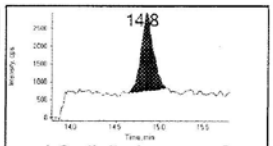
Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	11826	0.58	No
1,3_dinitrobenzene 2	14.80 (14.80)	21372	0.57	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1594900	57.20	No
Dinitroanaline 1	14.80 (14.80)	2946	0.12	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	35125	0.27	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	681800	3.27	No
PETN 1	21.80 (21.80)	3000	0.33	No
RDX 1	9.95 (9.93)	98819	3.27	No
HMX 1	7.32 (7.28)	50144	0.62	No
C13_hmx 1	7.31 (7.25)	2237600	50.60	No
2,4_dinitrotoluene 1	18.90 (18.90)	755	1.30	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	83026	0.13	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	12831	0.04	No

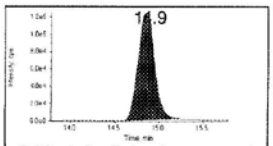
Quantitative Peak Review K1206334-001



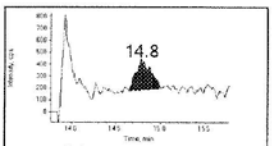
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



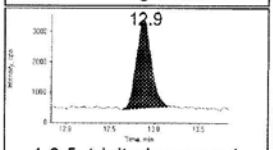
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



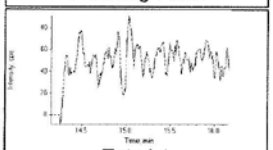
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



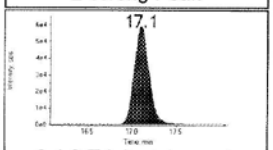
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



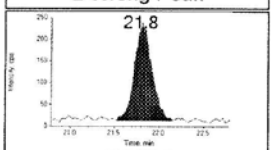
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



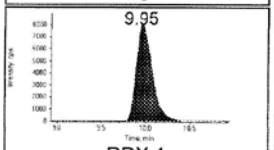
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



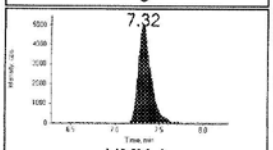
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



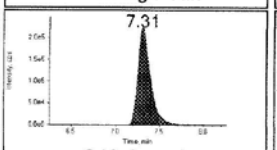
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



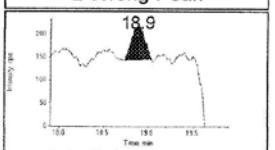
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



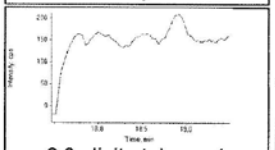
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



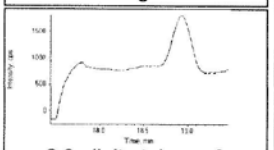
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



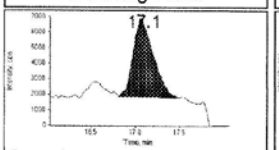
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



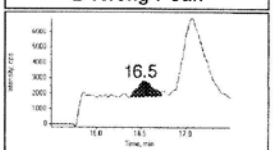
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/14/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061412	**Units:**	ng/Sample
Lab Code:	K1206334-002	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**74**	J	100	25	1	7/ 6/12	7/30/12 19:35	161950	302794	
RDX	**180**		100	18	1	7/ 6/12	7/30/12 19:35	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 19:35	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 19:35	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**74**	J	100	11	1	7/ 6/12	7/30/12 19:35	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 19:35	161950	302794	
2-Amino-4,6-dinitrotoluene	**14**	J	100	9.0	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,4-Dinitrotoluene	**200**		120	120	1	7/ 6/12	7/30/12 19:35	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 19:35	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 19:35	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 19:35	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	95	70-130	7/30/12 19:35	
1,3-Dinitrobenzene-C13	107	70-130	7/30/12 19:35	

Columbia Analytical Services™

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

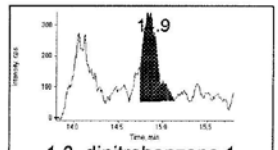
Sample Name	K1206334-002	**Injection Volume**	100
Acquisition Date	7/30/2012 7:35:00 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	12	**Weight to Volume**	0.00

Results Summary

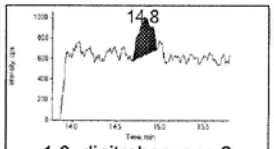
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	3119	0.06	No
1,3_dinitrobenzene 2	14.80 (14.80)	3955	0.03	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1492900	53.70	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	25741	0.22	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	167590	0.74	No
PETN 1	21.80 (21.80)	728	0.08	No
RDX 1	9.96 (9.93)	54576	1.81	No
HMX 1	7.31 (7.28)	62996	0.74	No
C13_hmx 1	7.30 (7.25)	2100400	47.70	No
2,4_dinitrotoluene 1	18.90 (18.90)	1357	2.05	Yes
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	85904	0.14	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

8/2/12

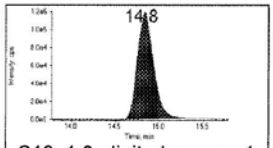
Quantitative Peak Review K1206334-002



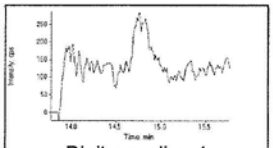
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



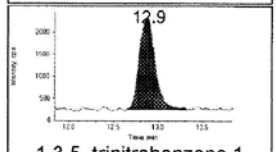
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



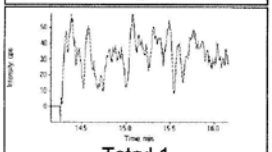
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



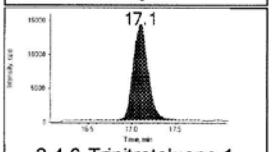
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



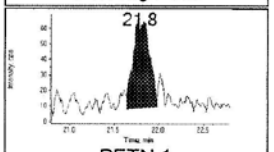
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



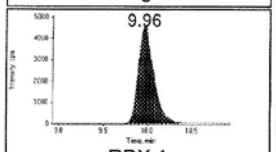
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



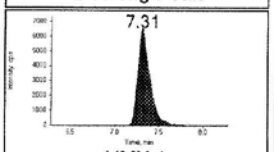
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



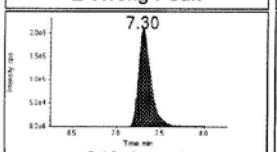
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



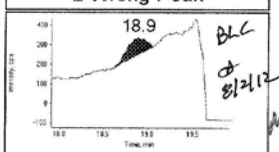
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak

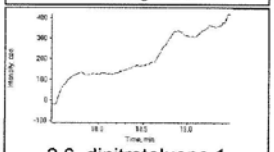


C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak

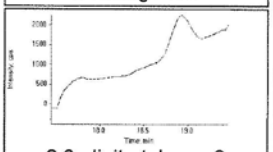


BLC
8/2/12

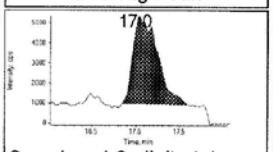
2,4_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



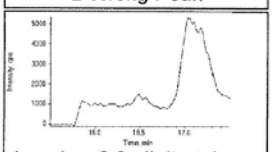
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



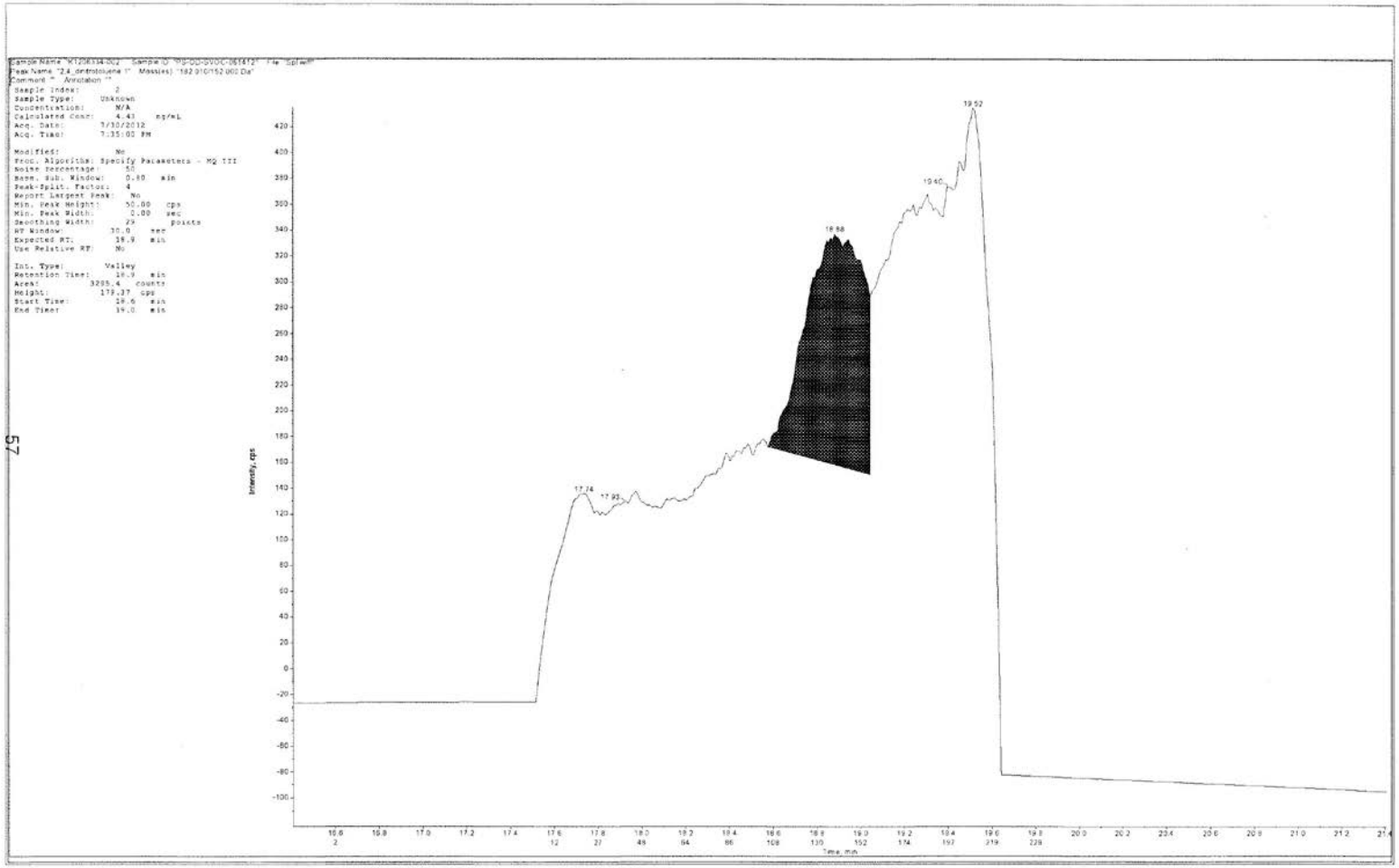
4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

Polarity/Scan Type: N/A
*Pre PM TESTING

*Tom Westlake. Senior FSE, AB Sciex
**API5000 SN: AG22300804

Printing Time: 9:35:44 AM
Printing Date: Thursday, August 02, 2012



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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/15/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061512	**Units:**	ng/Sample
Lab Code:	K1206334-003	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**26**	J	100	25	1	7/ 6/12	7/30/12 20:01	161950	302794	
RDX	**61**	J	100	18	1	7/ 6/12	7/30/12 20:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**11**	J	100	11	1	7/ 6/12	7/30/12 20:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:01	161950	302794	
2-Amino-4,6-dinitrotoluene	**16**	J	100	9.0	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,4-Dinitrotoluene	**320**		120	120	1	7/ 6/12	7/30/12 20:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:01	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 20:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	95	70-130	7/30/12 20:01	
1,3-Dinitrobenzene-C13	111	70-130	7/30/12 20:01	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

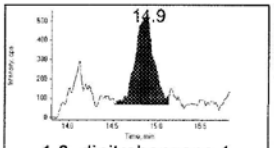
Sample Name	K1206334-003	**Injection Volume**	100
Acquisition Date	7/30/2012 8:01:39 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	13	**Weight to Volume**	0.00

Results Summary

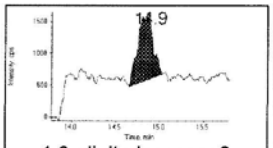
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	6787	0.28	No
1,3_dinitrobenzene 2	14.90 (14.80)	12563	0.30	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1539400	55.30	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	5272	0.10	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	40376	0.11	No
PETN 1	21.80 (21.80)	967	0.11	No
RDX 1	9.94 (9.93)	18092	0.61	No
HMX 1	7.31 (7.28)	11495	0.26	No
C13_hmx 1	7.30 (7.25)	2089600	47.40	No
2,4_dinitrotoluene 1	18.90 (18.90)	2263	3.16	Yes
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	106640	0.16	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	649	0.00	No

8/2/12

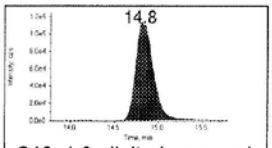
Quantitative Peak Review K1206334-003



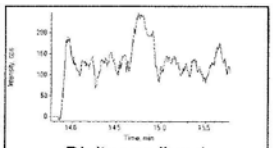
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



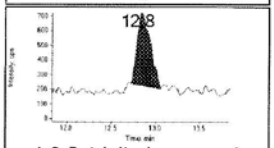
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



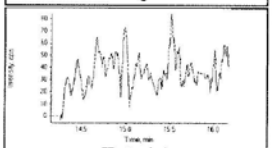
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



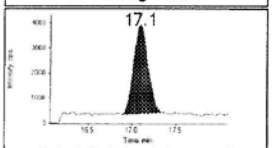
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



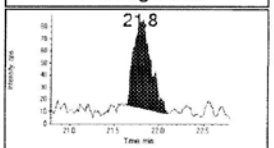
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



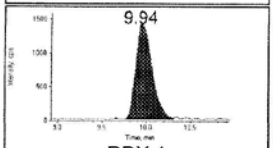
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



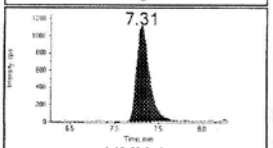
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



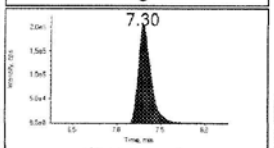
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



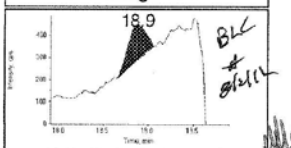
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



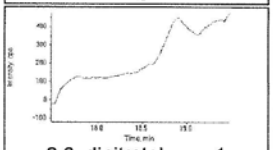
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



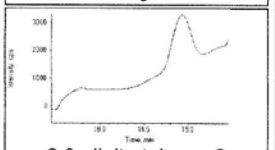
BLC
&
[illegible]

[illegible]

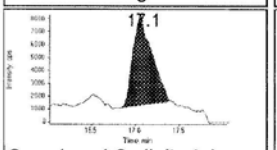
2,4_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



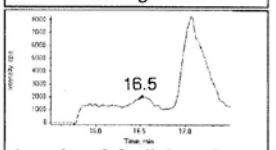
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

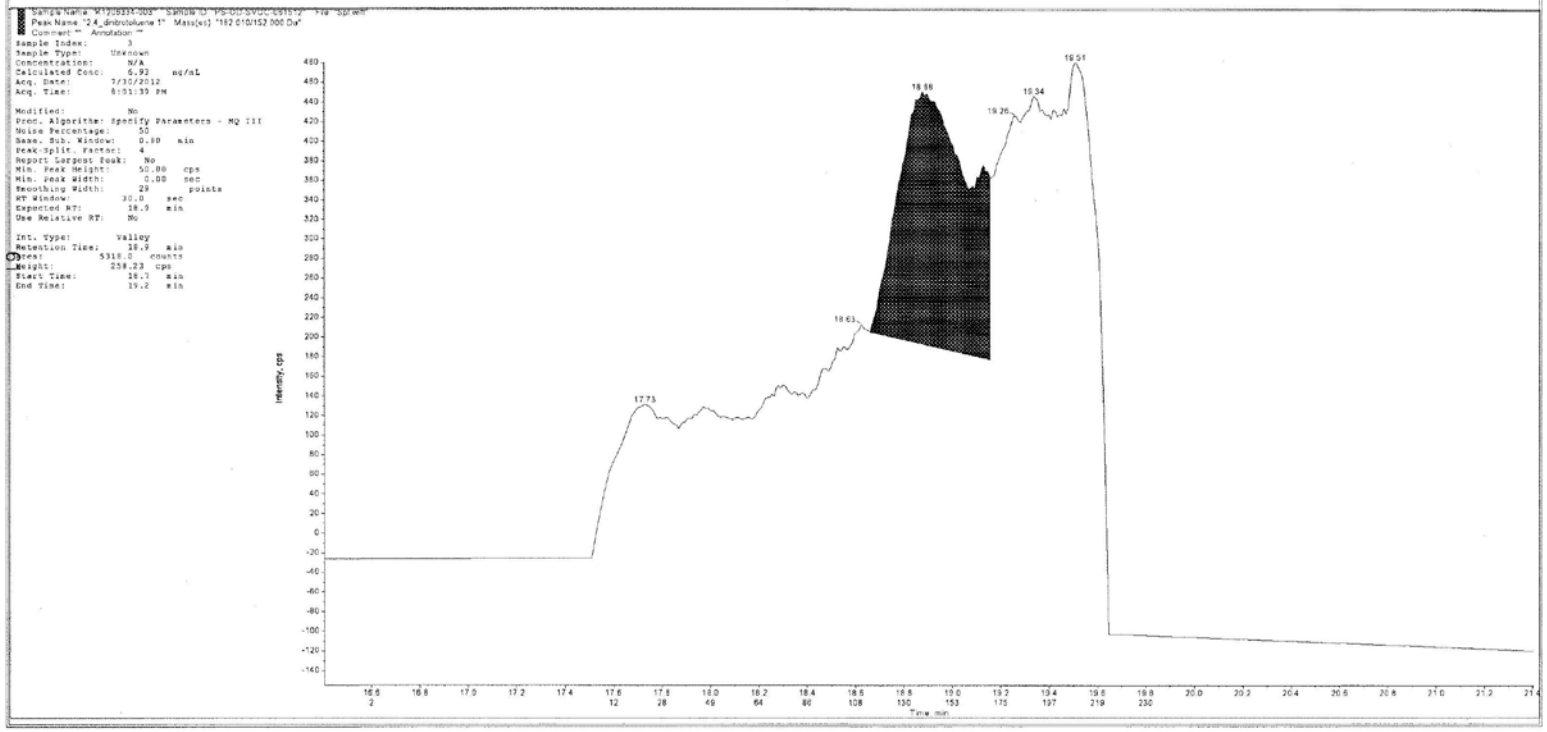
☐ Before ☐ After

Polarity/Scan Type: N/A
*Pre PM TESTING

*Tom Westlake. Senior FSE, AB Sciex
**API5000 SN: AG22300804

Printing Time: 9:38:32 AM
Printing Date: Thursday, August 02, 2012

	File Name	Sample Name	Sample Type	Analyte Peak Name	Analyte Peak Area (counts)	Analyte Concentration (ng/mL)	Calculated Concentration (ng/mL)
413	073012\Spl.wiff	K1206334-003	Unknown	2,4_dinitrotoluene 1	5318.0	N/A	6.93
414	073012\Spl.wiff	K1206334-003	Unknown	2,4_dinitrotoluene 2	283130.	N/A	0.791
415	073012\Spl.wiff	K1206334-003	Unknown	2,6_dinitrotoluene 1	0.0000	N/A	No Peak
416	073012\Spl.wiff	K1206334-003	Unknown	2,6_dinitrotoluene 2	0.0000	N/A	No Peak



COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-01	**Units:**	ng/Sample
Lab Code:	K1206334-004	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**27**	J	100	25	1	7/ 6/12	7/30/12 20:28	161950	302794	
RDX	**86**	J	100	18	1	7/ 6/12	7/30/12 20:28	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:28	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:28	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**16**	J	100	11	1	7/ 6/12	7/30/12 20:28	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:28	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,4-Dinitrotoluene	**560**		120	120	1	7/ 6/12	7/30/12 20:28	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:28	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:28	161950	302794	
PETN	**26**	J	100	20	1	7/ 6/12	7/30/12 20:28	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	88	70-130	7/30/12 20:28	
1,3-Dinitrobenzene-C13	101	70-130	7/30/12 20:28	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

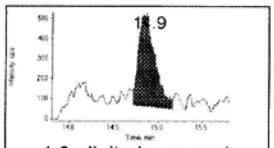
Sample Name	K1206334-004	**Injection Volume**	100
Acquisition Date	7/30/2012 8:28:18 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	14	**Weight to Volume**	0.00

Results Summary

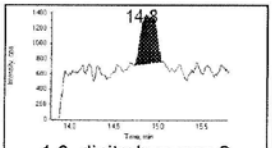
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	6108	0.24	No
1,3_dinitrobenzene 2	14.80 (14.80)	7762	0.15	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1397400	50.40	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	7203	0.11	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	50384	0.16	No
PETN 1	21.80 (21.80)	2318	0.26	No
RDX 1	9.96 (9.93)	25680	0.86	No
HMX 1	7.32 (7.28)	12095	0.27	No
C13_hmx 1	7.31 (7.25)	1942900	44.20	No
2,4_dinitrotoluene 1	18.90 (18.90)	4268	5.63	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	100940	0.15	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

8/2/12

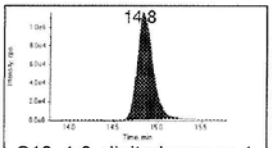
Quantitative Peak Review K1206334-004



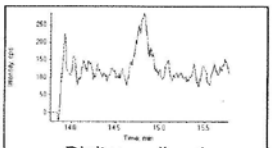
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



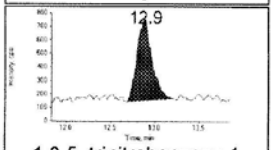
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



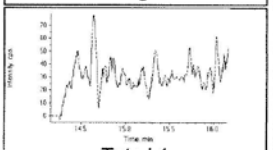
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



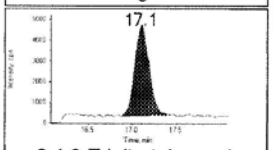
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



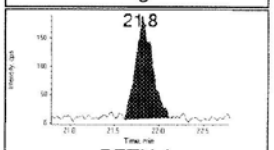
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



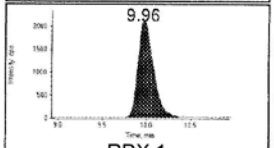
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



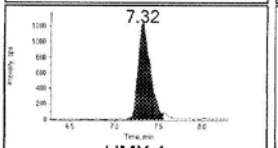
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



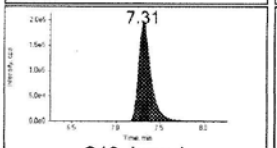
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



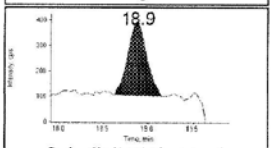
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



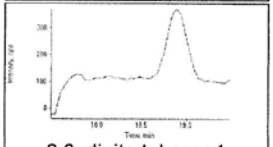
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



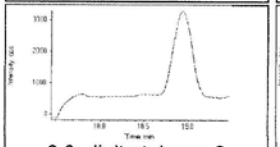
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



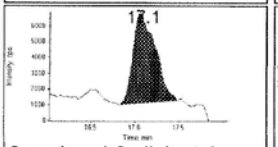
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



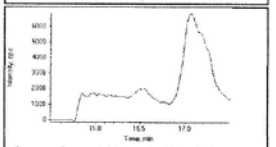
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-02	**Units:**	ng/Sample
Lab Code:	K1206334-005	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/30/12 20:54	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 20:54	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 20:54	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 20:54	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 20:54	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 20:54	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,4-Dinitrotoluene	**300**		120	120	1	7/ 6/12	7/30/12 20:54	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 20:54	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 20:54	161950	302794	
PETN	**27**	J	100	20	1	7/ 6/12	7/30/12 20:54	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	90	70-130	7/30/12 20:54	
1,3-Dinitrobenzene-C13	103	70-130	7/30/12 20:54	

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

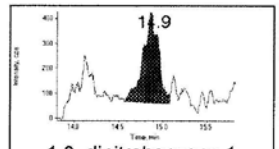
Sample Name	K1206334-005	**Injection Volume**	100
Acquisition Date	7/30/2012 8:54:58 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	15	**Weight to Volume**	0.00

Results Summary

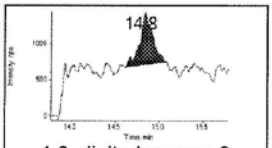
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	4478	0.14	No
1,3_dinitrobenzene 2	14.80 (14.80)	7539	0.14	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1432400	51.60	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	3203	0.09	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	27442	0.05	No
PETN 1	21.80 (21.80)	2427	0.27	No
RDX 1	9.97 (9.93)	3251	0.12	No
HMX 1	7.32 (7.28)	6190	0.21	No
C13_hmx 1	7.31 (7.25)	1984800	45.10	No
2,4_dinitrotoluene 1	18.90 (18.90)	2162	3.04	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	96101	0.15	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

8/2/12

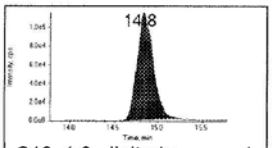
Quantitative Peak Review K1206334-005



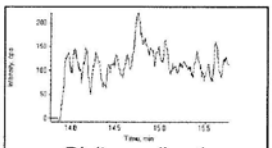
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



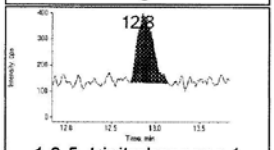
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



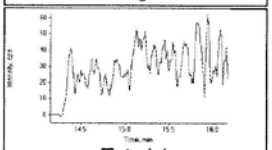
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



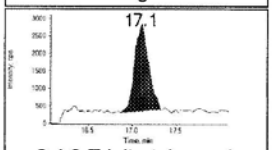
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



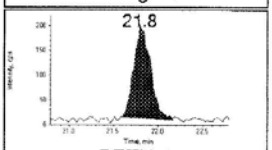
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



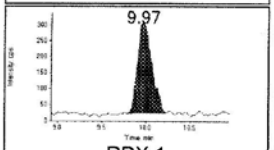
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



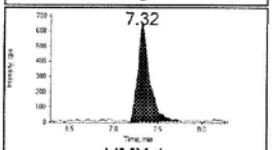
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



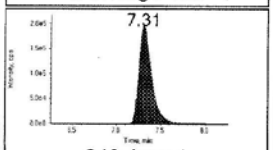
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



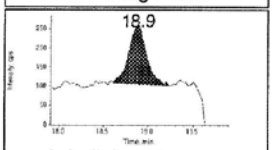
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



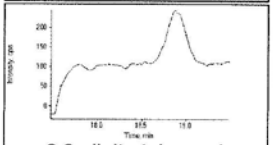
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



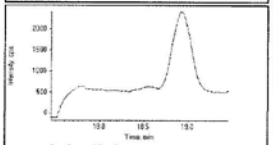
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



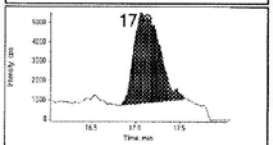
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



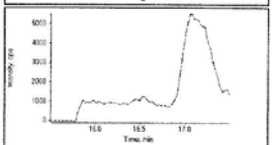
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/16/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061612-03	**Units:**	ng/Sample
Lab Code:	K1206334-006	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**45**	J	100	25	1	7/ 6/12	7/30/12 21:21	161950	302794	
RDX	**55**	J	100	18	1	7/ 6/12	7/30/12 21:21	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 21:21	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 21:21	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 21:21	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 21:21	161950	302794	
2-Amino-4,6-dinitrotoluene	**11**	J	100	9.0	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,4-Dinitrotoluene	**490**		120	120	1	7/ 6/12	7/30/12 21:21	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 21:21	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 21:21	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 21:21	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	88	70-130	7/30/12 21:21	
1,3-Dinitrobenzene-C13	105	70-130	7/30/12 21:21	

Columbia Analytical Services

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

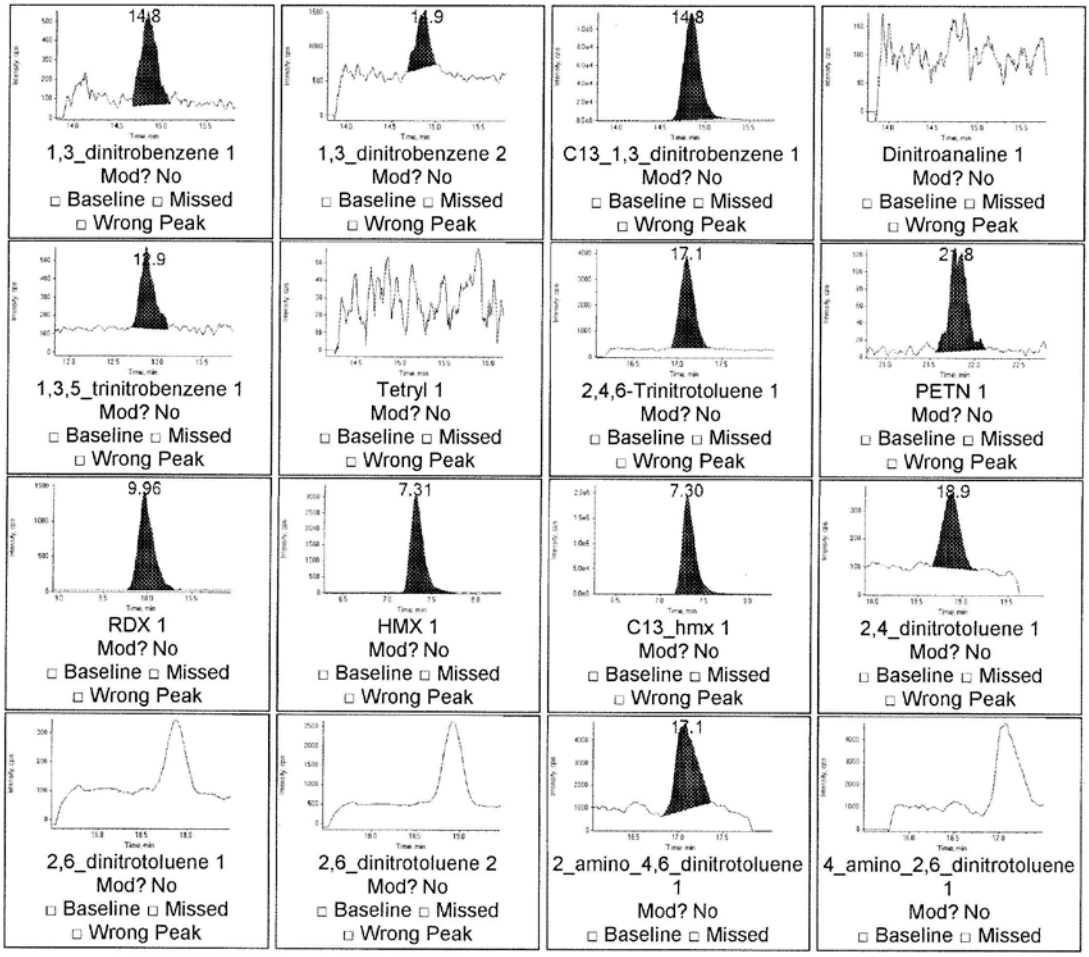
Sample Name	K1206334-006	**Injection Volume**	100
Acquisition Date	7/30/2012 9:21:37 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	16	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	5974	0.23	No
1,3_dinitrobenzene 2	14.90 (14.80)	8423	0.17	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1460000	52.60	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	4623	0.10	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	38633	0.10	No
PETN 1	21.80 (21.80)	1608	0.18	No
RDX 1	9.96 (9.93)	16038	0.55	No
HMX 1	7.31 (7.28)	31232	0.45	No
C13_hmx 1	7.30 (7.25)	1935900	44.10	No
2,4_dinitrotoluene 1	18.90 (18.90)	3636	4.85	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	62571	0.11	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

8/2/12

Quantitative Peak Review K1206334-006



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061812-01	**Units:**	ng/Sample
Lab Code:	K1206334-007	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**32**	J	100	25	1	7/ 6/12	7/30/12 21:48	161950	302794	
RDX	**110**		100	18	1	7/ 6/12	7/30/12 21:48	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 21:48	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 21:48	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**89**	J	100	11	1	7/ 6/12	7/30/12 21:48	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 21:48	161950	302794	
2-Amino-4,6-dinitrotoluene	**9.0**	J	100	9.0	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 21:48	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 21:48	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 21:48	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 21:48	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	84	70-130	7/30/12 21:48	
1,3-Dinitrobenzene-C13	108	70-130	7/30/12 21:48	

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Printed: 8/2/2012 7:45 AM

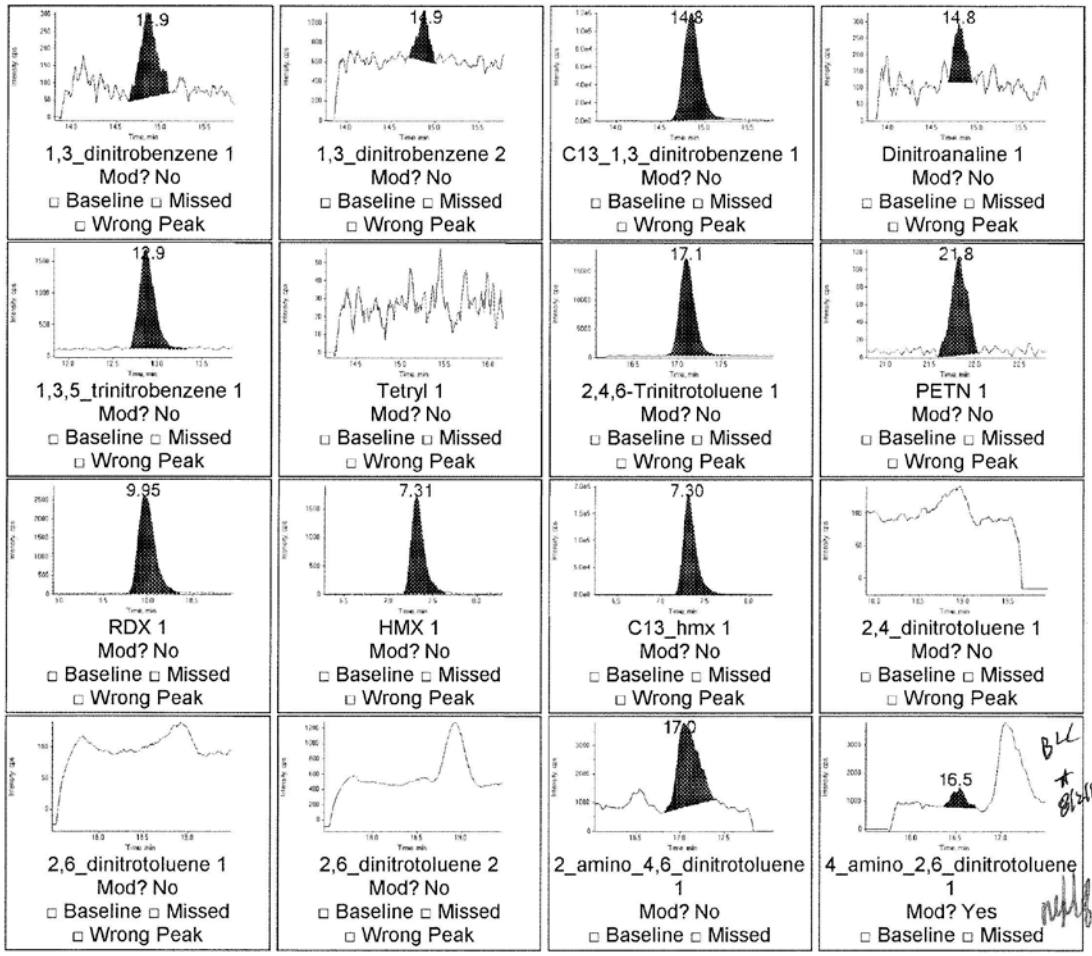
Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-007	**Injection Volume**	100
Acquisition Date	7/30/2012 9:48:16 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	17	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	3269	0.07	No
1,3_dinitrobenzene 2	14.90 (14.80)	4442	0.04	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1507800	54.20	No
Dinitroanaline 1	14.80 (14.80)	1536	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	18882	0.18	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	198720	0.89	No
PETN 1	21.80 (21.80)	1402	0.16	No
RDX 1	9.95 (9.93)	33630	1.12	No
HMX 1	7.31 (7.28)	17423	0.32	No
C13_hmx 1	7.30 (7.25)	1847100	42.10	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	48512	0.09	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	7560	0.02	Yes

Quantitative Peak Review K1206334-007



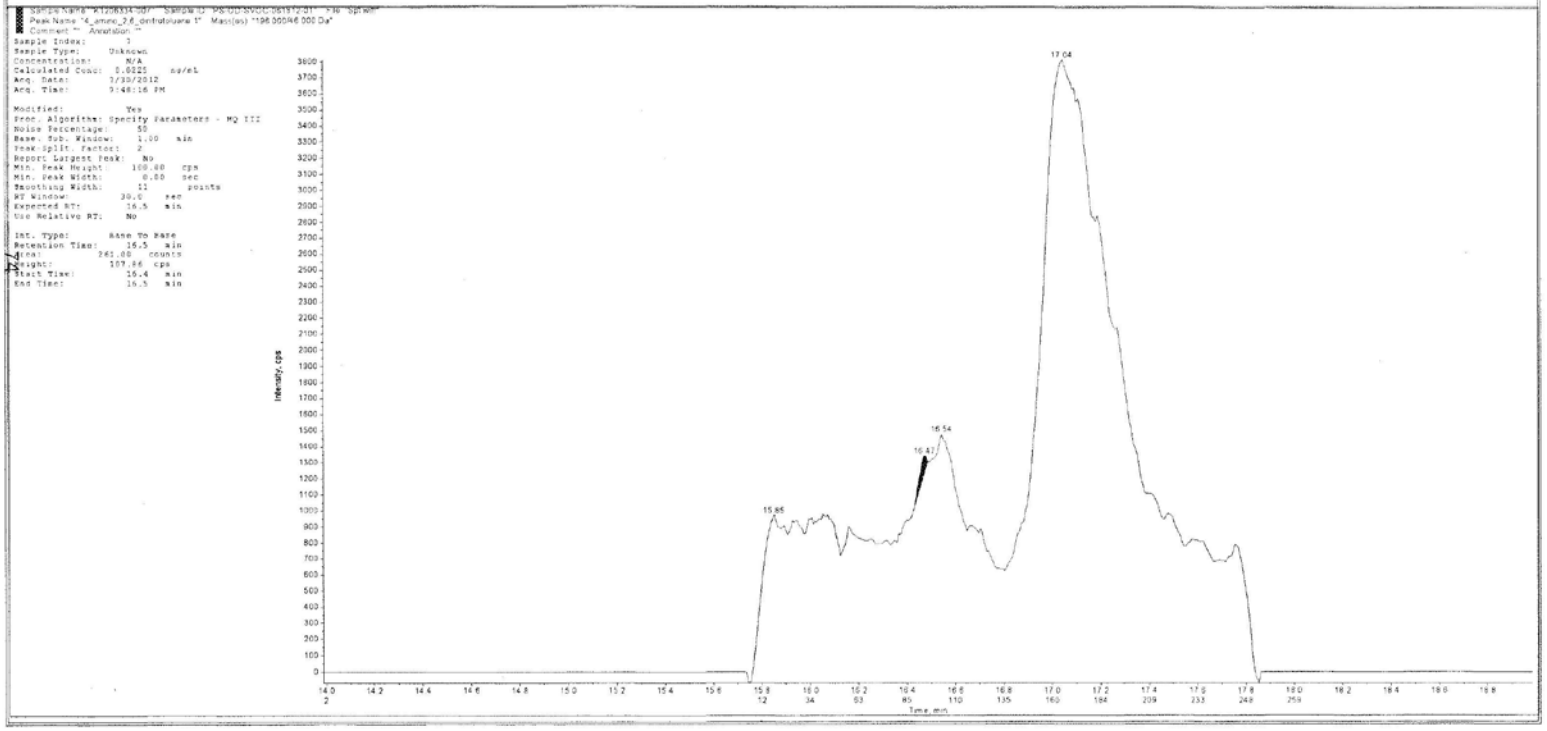
☐ Before ☐ After

Polarity/Scan Type: N/A
*Pre PM TESTING

*Tom Westlake. Senior FSE, AB Sciex
**API5000 SN: AG22300804

Printing Time: 9:40:30 AM
Printing Date: Thursday, August 02, 2012

	File Name	Sample Name	Sample Type	Analyte Peak Name	Analyte Peak Area (counts)	Analyte Concentration (ng/mL)	Calculated Concentration (ng/mL)
531	073012\Spl.wiff	K1206334-007	Unknown	4_amino_2,6_dinitr	7559.7	N/A	0.0225
532	073012\Spl.wiff	K1206334-007	Unknown	4_amino_2,6_dinitr	0.0000	N/A	No Peak
533	073012\Spl.wiff	K1206334-008	Unknown	1,3_dinitrobenzene	0.0000	N/A	No Peak
534	073012\Spl.wiff	K1206334-008	Unknown	1,3_dinitrobenzene	0.0000	N/A	No Peak



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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061812-02	**Units:**	ng/Sample
Lab Code:	K1206334-008	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/30/12 22:14	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 22:14	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 22:14	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 22:14	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 22:14	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 22:14	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 22:14	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 22:14	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 22:14	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 22:14	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	82	70-130	7/30/12 22:14	
1,3-Dinitrobenzene-C13	96	70-130	7/30/12 22:14	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-008	**Injection Volume**	100
Acquisition Date	7/30/2012 10:14:56 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	18	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1323300	47.80	No
Dinitroanaline 1	14.80 (14.80)	1567	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	2725	0.09	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	9903	N/A	No
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	9.96 (9.93)	3155	0.12	No
HMX 1	7.31 (7.28)	5427	0.21	No
C13_hmx 1	7.30 (7.25)	1802200	41.10	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	31825	0.07	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

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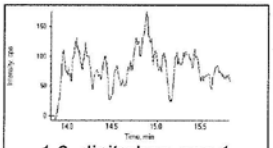
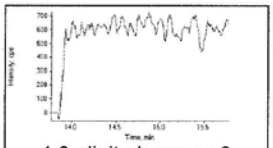
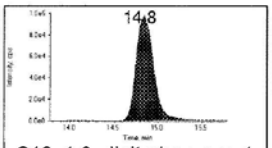
Quantitative Peak Review K1206334-008



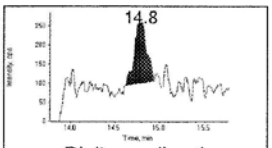
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



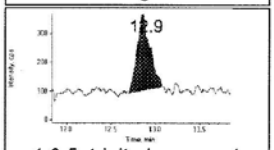
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



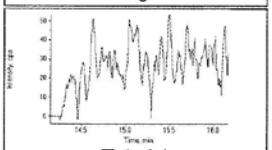
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



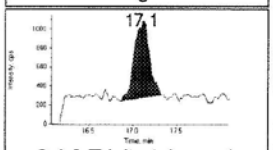
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



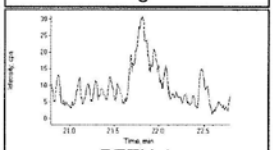
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



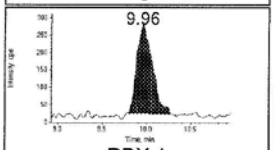
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



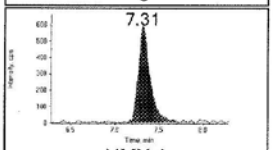
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



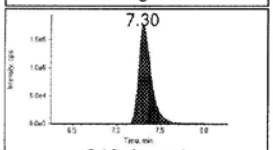
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



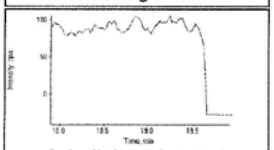
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



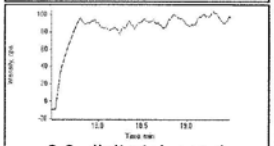
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



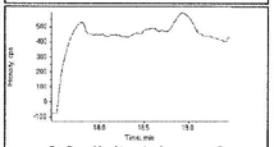
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



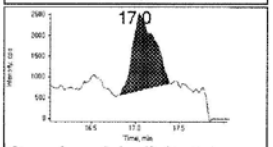
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



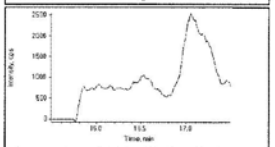
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/19/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-061912	**Units:**	ng/Sample
Lab Code:	K1206334-009	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**31**	J	100	25	1	7/ 6/12	7/30/12 22:41	161950	302794	
RDX	**34**	J	100	18	1	7/ 6/12	7/30/12 22:41	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 22:41	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 22:41	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 22:41	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 22:41	161950	302794	
2-Amino-4,6-dinitrotoluene	**15**	J	100	9.0	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 22:41	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 22:41	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 22:41	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 22:41	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	93	70-130	7/30/12 22:41	
1,3-Dinitrobenzene-C13	105	70-130	7/30/12 22:41	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

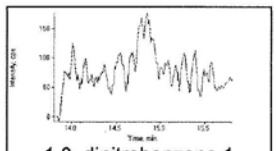
Sample Name	K1206334-009	**Injection Volume**	100
Acquisition Date	7/30/2012 10:41:34 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	19	**Weight to Volume**	0.00

Results Summary

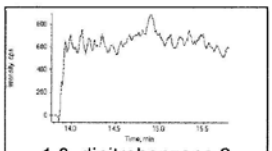
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	Yes a2d
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1459200	52.50	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	4516	0.10	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	13190	N/A	No
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	9.96 (9.93)	9683	0.34	No
HMX 1	7.31 (7.28)	16307	0.31	No
C13_hmx 1	7.31 (7.25)	2043800	46.40	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	100730	0.15	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

8/2/12

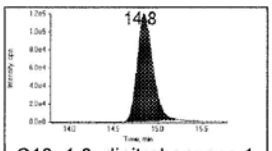
Quantitative Peak Review K1206334-009



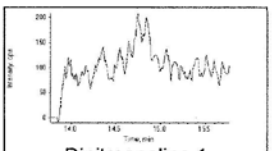
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



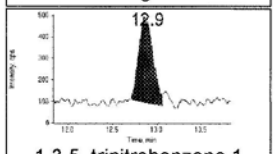
1,3_dinitrobenzene 2
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



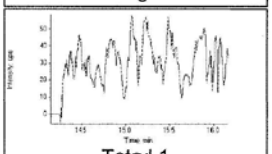
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



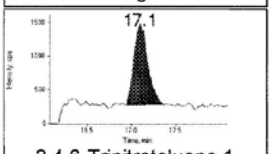
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



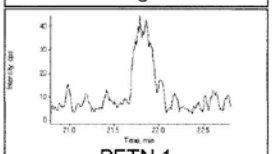
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



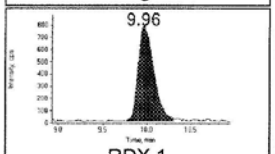
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



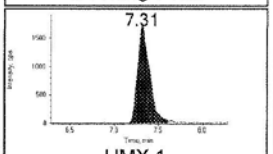
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



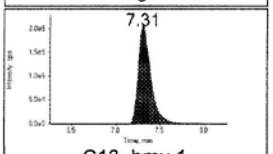
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



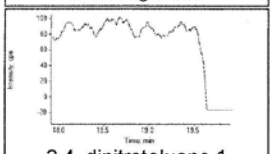
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



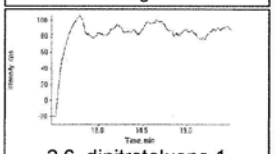
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



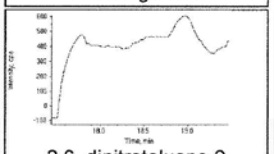
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



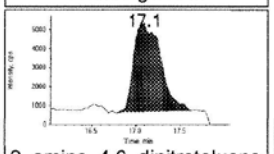
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



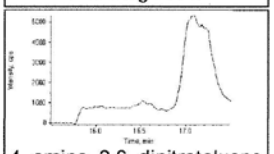
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/20/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062012	**Units:**	ng/Sample
Lab Code:	K1206334-010	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**35**	J	100	25	1	7/ 6/12	7/30/12 23:08	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/30/12 23:08	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/30/12 23:08	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/30/12 23:08	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/30/12 23:08	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/30/12 23:08	161950	302794	
2-Amino-4,6-dinitrotoluene	**11**	J	100	9.0	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/30/12 23:08	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/30/12 23:08	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/30/12 23:08	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/30/12 23:08	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	89	70-130	7/30/12 23:08	
1,3-Dinitrobenzene-C13	104	70-130	7/30/12 23:08	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

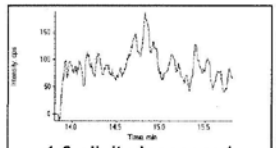
Sample Name	K1206334-010	**Injection Volume**	100
Acquisition Date	7/30/2012 11:08:13 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	20	**Weight to Volume**	0.00

Results Summary

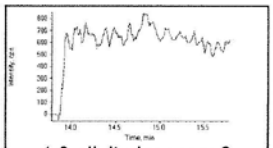
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1445400	52.10	No
Dinitroanaline 1	14.80 (14.80)	2396	0.11	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	850	0.08	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	11852	N/A	No
PETN 1	21.80 (21.80)	561	0.06	No
RDX 1	9.98 (9.93)	2173	0.09	No
HMX 1	7.32 (7.28)	20546	0.35	No
C13_hmx 1	7.31 (7.25)	1953000	44.40	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	66571	0.11	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	Yes

NK 8/10/12 8/2/12

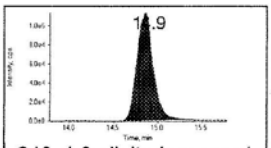
Quantitative Peak Review K1206334-010



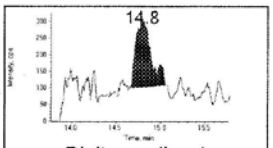
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



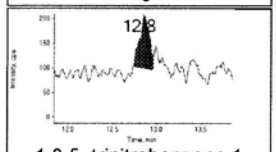
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



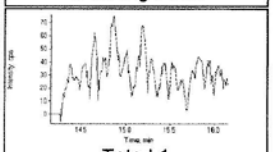
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



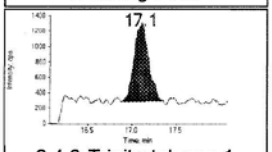
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



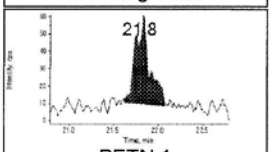
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



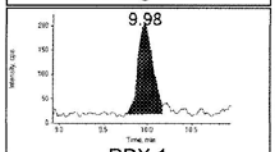
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



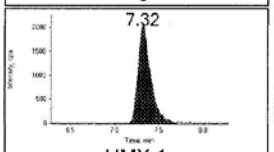
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



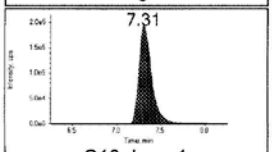
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



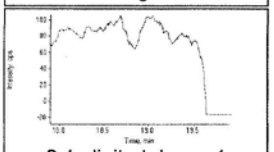
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



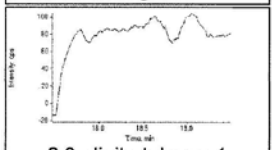
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



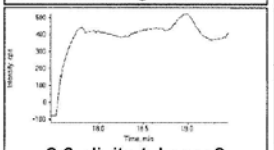
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



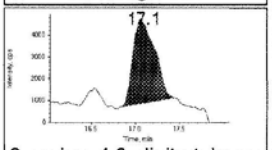
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



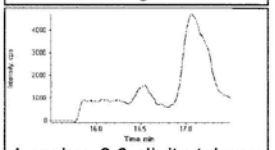
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/21/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062112-01	**Units:**	ng/Sample
Lab Code:	K1206334-011	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/31/12 00:01	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 00:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:01	161950	302794	
2-Amino-4,6-dinitrotoluene	**10**	J	100	9.0	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:01	161950	302794	
3,5-Dinitroaniline	**13**	J	100	12	1	7/ 6/12	7/31/12 00:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 00:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	87	70-130	7/31/12 00:01	
1,3-Dinitrobenzene-C13	100	70-130	7/31/12 00:01	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

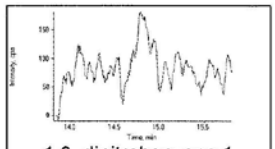
Sample Name	K1206334-011	**Injection Volume**	100
Acquisition Date	7/31/2012 12:01:34 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	21	**Weight to Volume**	0.00

Results Summary

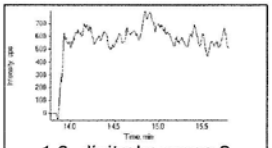
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1389100	50.10	No
Dinitroanaline 1	14.80 (14.80)	5109	0.13	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	2290	0.08	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	9686	N/A	No
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	9.98 (9.93)	1009	0.05	No
HMX 1	7.30 (7.28)	5455	0.21	No
C13_hmx 1	7.30 (7.25)	1918400	43.70	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	60021	0.10	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	11966	0.04	No

8/10/12 8/13/12

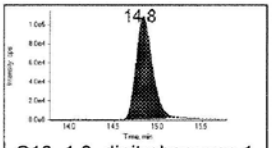
Quantitative Peak Review K1206334-011



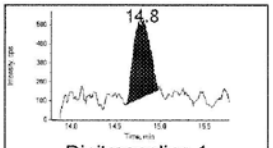
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



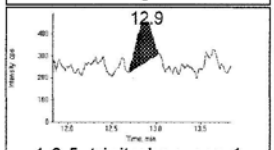
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



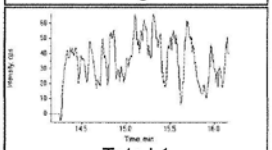
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



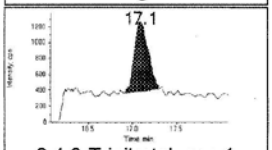
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



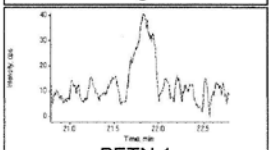
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



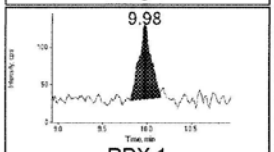
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



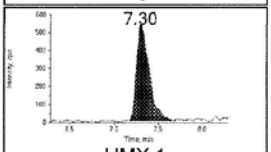
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



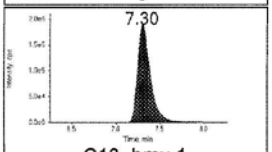
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



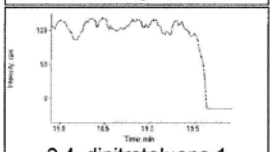
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



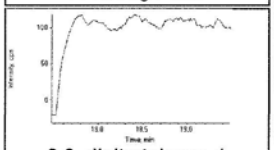
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



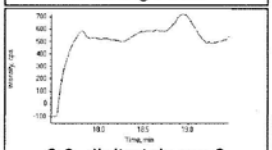
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



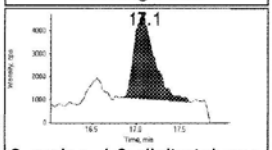
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



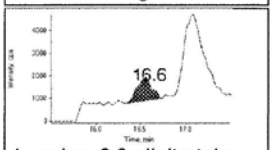
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/21/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062112-02	**Units:**	ng/Sample
Lab Code:	K1206334-012	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**31**	J	100	25	1	7/ 6/12	7/31/12 00:28	161950	302794	
RDX	**30**	J	100	18	1	7/ 6/12	7/31/12 00:28	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:28	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:28	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:28	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:28	161950	302794	
2-Amino-4,6-dinitrotoluene	**16**	J	100	9.0	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:28	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:28	161950	302794	
3,5-Dinitroaniline	**13**	J	100	12	1	7/ 6/12	7/31/12 00:28	161950	302794	
PETN	**31**	J	100	20	1	7/ 6/12	7/31/12 00:28	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	89	70-130	7/31/12 00:28	
1,3-Dinitrobenzene-C13	104	70-130	7/31/12 00:28	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

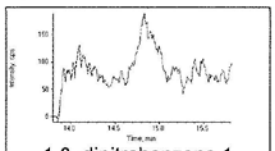
Sample Name	K1206334-012	**Injection Volume**	100
Acquisition Date	7/31/2012 12:28:13 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	22	**Weight to Volume**	0.00

Results Summary

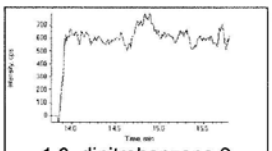
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1437900	51.80	No
Dinitroanaline 1	14.80 (14.80)	5461	0.13	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	2936	0.09	No
Tetryl 1	15.20 (15.20)	2637	0.01	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	14242	N/A	No
PETN 1	21.80 (21.80)	2822	0.31	No
RDX 1	9.96 (9.93)	8582	0.30	No
HMX 1	7.30 (7.28)	16150	0.31	No
C13_hmx 1	7.30 (7.25)	1949400	44.40	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	105960	0.16	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	19391	0.06	No

MJL 8/10/12 — 8/2/12

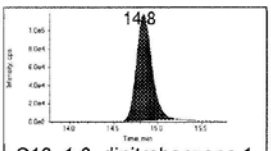
Quantitative Peak Review K1206334-012



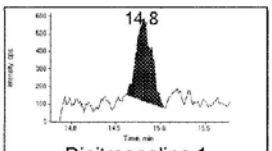
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



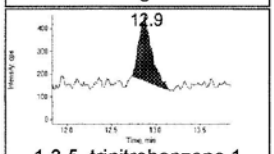
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



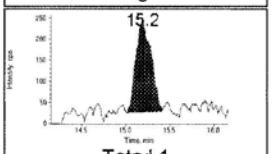
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



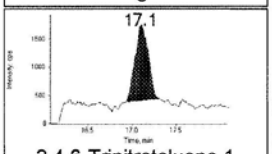
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



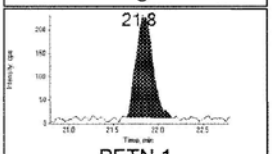
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



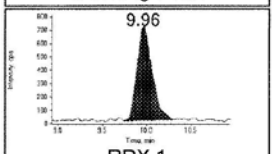
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



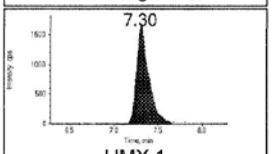
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



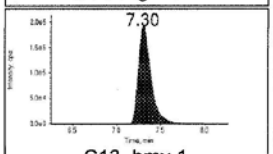
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



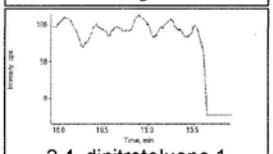
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



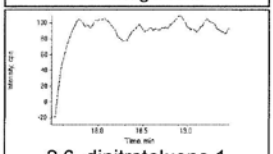
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



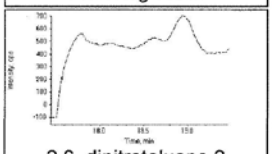
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



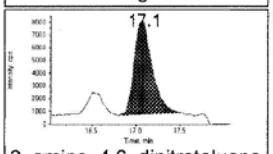
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



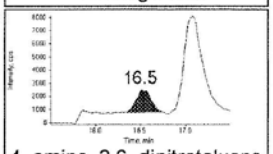
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/22/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062212	**Units:**	ng/Sample
Lab Code:	K1206334-013	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**1700**		100	25	1	7/ 6/12	7/31/12 00:54	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 00:54	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 00:54	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 00:54	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 00:54	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 00:54	161950	302794	
2-Amino-4,6-dinitrotoluene	**12**	J	100	9.0	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 00:54	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 00:54	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 00:54	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 00:54	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	81	70-130	7/31/12 00:54	
1,3-Dinitrobenzene-C13	93	70-130	7/31/12 00:54	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

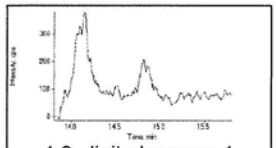
Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-013	**Injection Volume**	100
Acquisition Date	7/31/2012 12:54:52 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	23	**Weight to Volume**	0.00

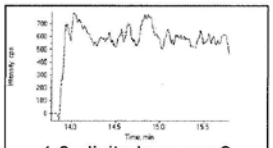
Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1291300	46.70	No
Dinitroanaline 1	14.80 (14.80)	2797	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	2252	0.08	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	0.00 (17.10)	0	N/A	Yes
PETN 1	21.80 (21.80)	1042	0.12	No
RDX 1	9.95 (9.93)	1480	0.07	No
HMX 1	7.30 (7.28)	1776600	16.60	No
C13_hmx 1	7.29 (7.25)	1782000	40.70	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	72126	0.12	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	Yes

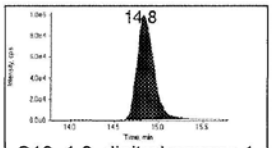
Quantitative Peak Review K1206334-013



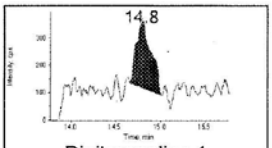
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



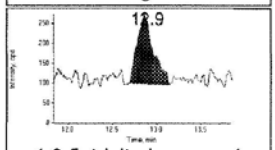
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



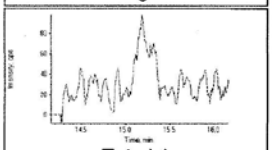
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



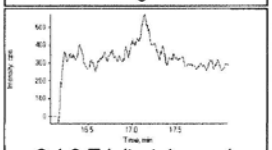
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



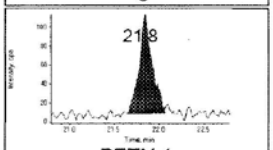
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



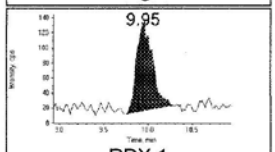
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



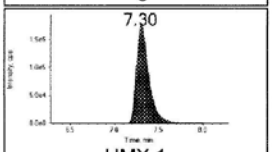
2,4,6-Trinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



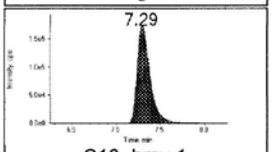
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



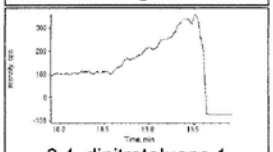
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



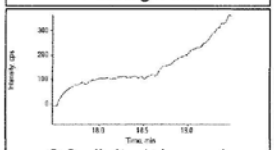
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



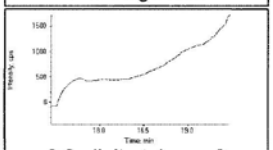
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



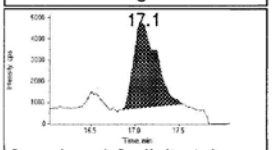
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



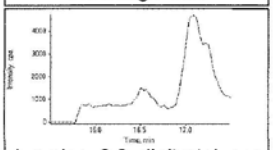
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/25/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062512-01	**Units:**	ng/Sample
Lab Code:	K1206334-014	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**2000**		100	25	1	7/ 6/12	7/31/12 01:21	161950	302794	
RDX	**19**	J	100	18	1	7/ 6/12	7/31/12 01:21	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 01:21	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 01:21	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 01:21	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 01:21	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 01:21	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 01:21	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 01:21	161950	302794	
PETN	**85**	J	100	20	1	7/ 6/12	7/31/12 01:21	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	74	70-130	7/31/12 01:21	
1,3-Dinitrobenzene-C13	86	70-130	7/31/12 01:21	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-014	**Injection Volume**	100
Acquisition Date	7/31/2012 1:21:31 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	24	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1191200	43.20	No
Dinitroanaline 1	14.80 (14.80)	1428	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	4224	0.09	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	0.00 (17.10)	0	N/A	Yes
PETN 1	21.90 (21.80)	7797	0.85	No
RDX 1	9.96 (9.93)	5369	0.19	No
HMX 1	7.30 (7.28)	2166700	20.20	No
C13_hmx 1	7.30 (7.25)	1605000	36.80	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	39176	0.08	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

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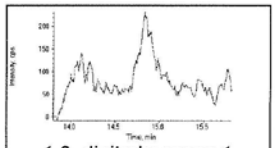
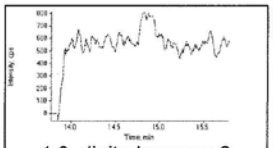
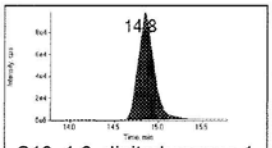
Quantitative Peak Review K1206334-014



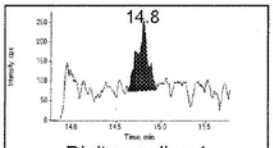
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



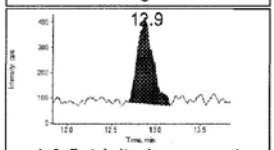
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



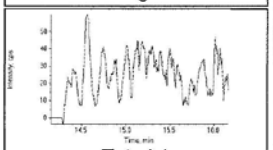
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



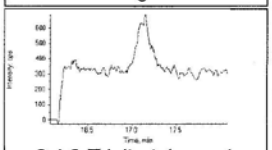
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



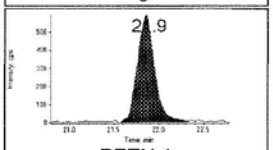
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



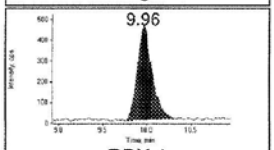
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



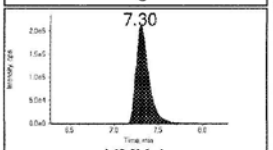
2,4,6-Trinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



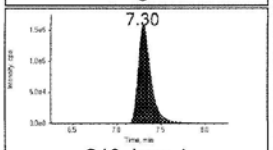
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



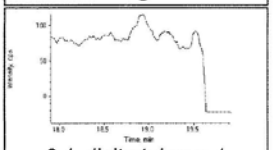
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



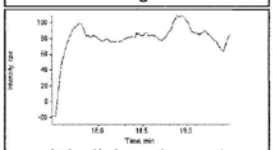
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



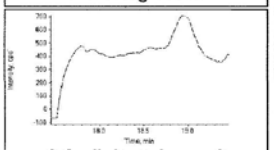
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



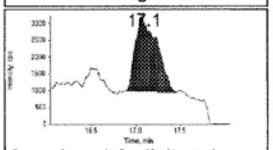
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



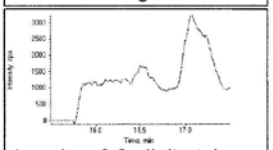
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/25/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062512-02	**Units:**	ng/Sample
Lab Code:	K1206334-015	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**210**		100	25	1	7/ 6/12	7/31/12 01:48	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 01:48	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 01:48	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 01:48	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**45**	J	100	11	1	7/ 6/12	7/31/12 01:48	161950	302794	
4-Amino-2,6-dinitrotoluene	**24**	J	100	16	1	7/ 6/12	7/31/12 01:48	161950	302794	
2-Amino-4,6-dinitrotoluene	**17**	J	100	9.0	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 01:48	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 01:48	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 01:48	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 01:48	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	85	70-130	7/31/12 01:48	
1,3-Dinitrobenzene-C13	105	70-130	7/31/12 01:48	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

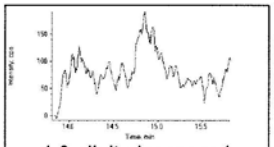
Sample Name	K1206334-015	**Injection Volume**	100
Acquisition Date	7/31/2012 1:48:10 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	25	**Weight to Volume**	0.00

Results Summary

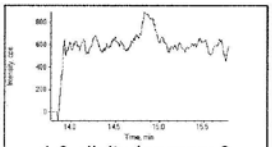
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1459300	52.50	No
Dinitroanaline 1	14.80 (14.80)	2132	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	11122	0.14	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	108510	0.45	No
PETN 1	21.90 (21.80)	1626	0.18	No
RDX 1	9.99 (9.93)	3996	0.15	No
HMX 1	7.31 (7.28)	210870	2.12	No
C13_hmx 1	7.31 (7.25)	1859900	42.40	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	110390	0.17	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	74314	0.24	No

8/2/12

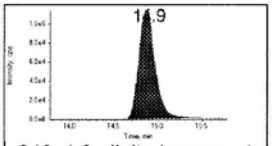
Quantitative Peak Review K1206334-015



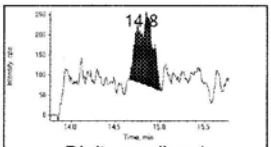
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



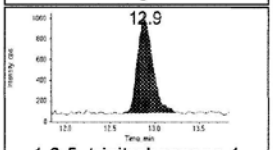
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



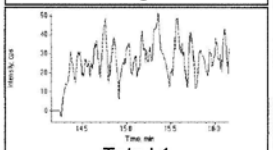
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



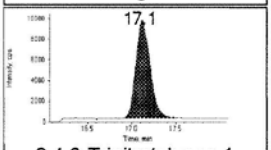
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



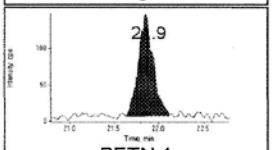
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



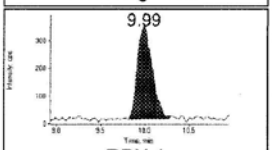
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



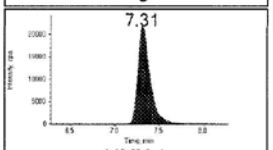
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



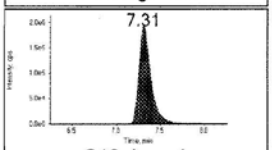
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



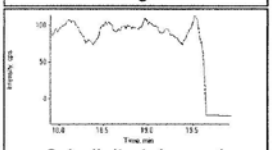
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



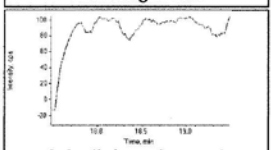
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



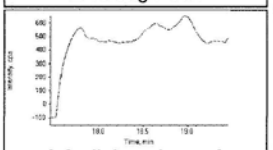
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



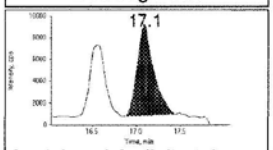
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



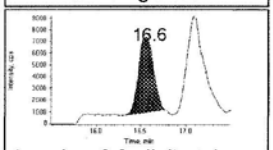
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/26/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062612	**Units:**	ng/Sample
Lab Code:	K1206334-016	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**2200**		100	25	1	7/ 6/12	7/31/12 02:14	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 02:14	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 02:14	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 02:14	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 02:14	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 02:14	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 02:14	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 02:14	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 02:14	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 02:14	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	86	70-130	7/31/12 02:14	
1,3-Dinitrobenzene-C13	100	70-130	7/31/12 02:14	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206334-016	**Injection Volume**	100
Acquisition Date	7/31/2012 2:14:50 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	26	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1379500	49.80	No
Dinitroanaline 1	14.80 (14.80)	2642	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	3649	0.09	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	4934	N/A	No
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	10.00 (9.93)	2659	0.10	No
HMX 1	7.32 (7.28)	2361500	22.00	No
C13_hmx 1	7.32 (7.25)	1878600	42.80	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	38116	0.08	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	Yes

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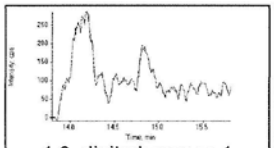
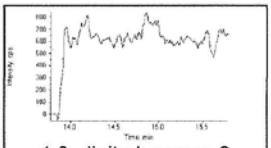
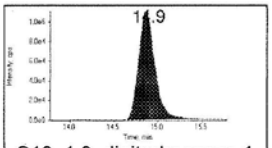
Quantitative Peak Review K1206334-016



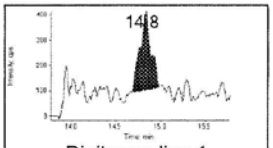
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



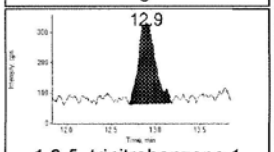
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



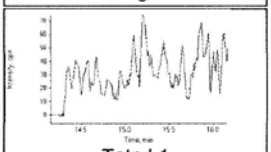
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



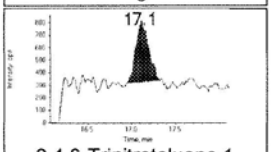
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



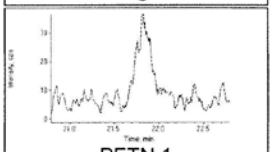
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



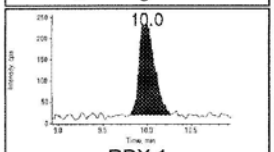
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



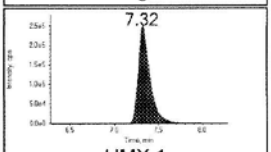
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



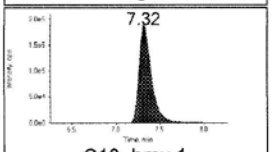
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



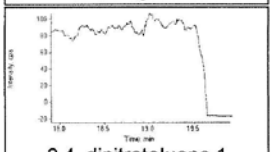
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



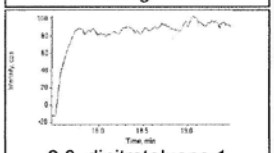
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



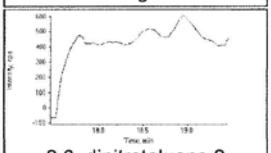
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



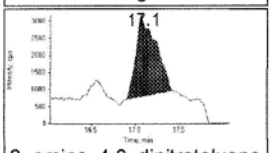
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



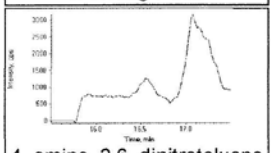
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Filter	**Date Received:**	6/30/12
Sample Name:	PS-OD-SVOC-062812	**Units:**	ng/Sample
Lab Code:	K1206334-017	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**36**	J	100	25	1	7/ 6/12	7/31/12 02:41	161950	302794	
RDX	**35**	J	100	18	1	7/ 6/12	7/31/12 02:41	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 02:41	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 02:41	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**60**	J	100	11	1	7/ 6/12	7/31/12 02:41	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 02:41	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,4-Dinitrotoluene	**540**		120	120	1	7/ 6/12	7/31/12 02:41	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 02:41	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 02:41	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 02:41	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	83	70-130	7/31/12 02:41	
1,3-Dinitrobenzene-C13	91	70-130	7/31/12 02:41	

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

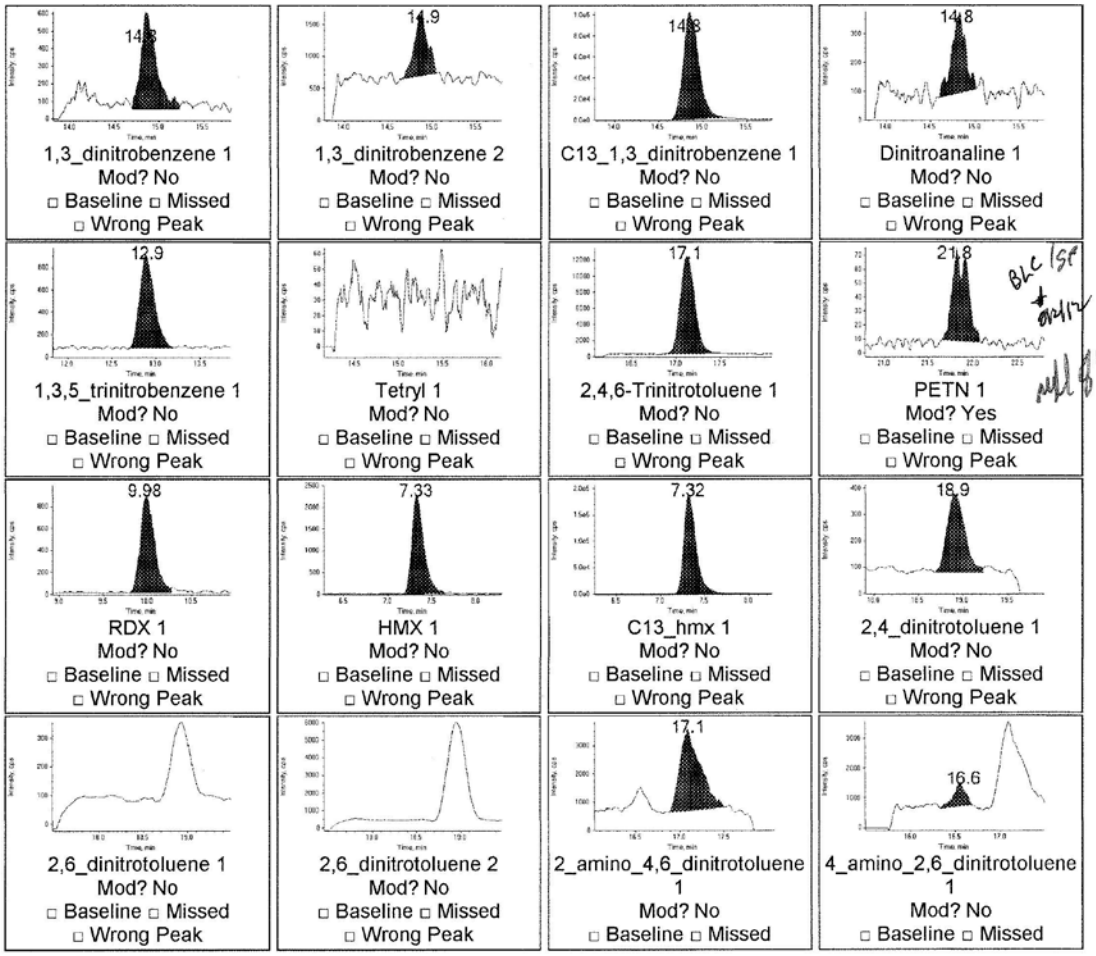
Sample Name	K1206334-017	**Injection Volume**	100
Acquisition Date	7/31/2012 2:41:28 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	27	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	6854	0.28	No
1,3_dinitrobenzene 2	14.90 (14.80)	10584	0.24	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1250900	45.30	No
Dinitroanaline 1	14.80 (14.80)	2979	0.12	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	9737	0.13	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	140290	0.60	No
PETN 1	21.80 (21.80)	772	0.09	Yes
RDX 1	9.98 (9.93)	10023	0.35	No
HMX 1	7.33 (7.28)	22162	0.36	No
C13_hmx 1	7.32 (7.25)	1828200	41.70	No
2,4_dinitrotoluene 1	18.90 (18.90)	4099	5.42	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	46906	0.09	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	7565	0.02	No

8/2/12

Quantitative Peak Review K1206334-017



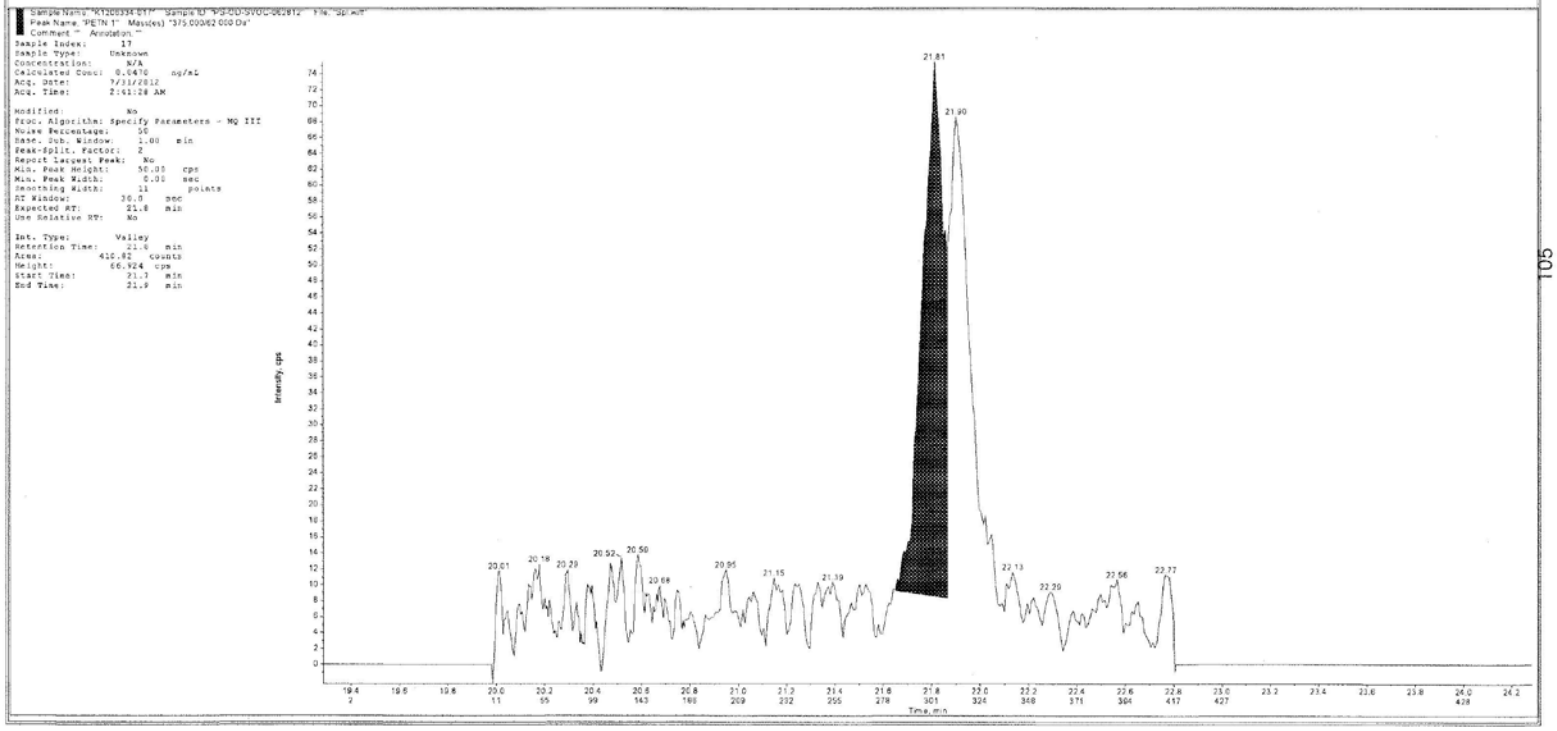
☐ Before ☐ After

Polarity/Scan Type: N/A
*Pre PM TESTING

*Tom Westlake. Senior FSE, AB Sciex
**API5000 SN: AG22300804

Printing Time: 9:49:41 AM
Printing Date: Thursday, August 02, 2012

	File Name	Sample Name	Sample Type	Analyte Peak Name	Analyte Peak Area (counts)	Analyte Concentration (ng/mL)	Calculated Concentration (ng/mL)
824	073012\Spl.wiff	K1206334-017	Unknown	2,4,6-Trinitrotoluen	33015.	N/A	0.727
825	073012\Spl.wiff	K1206334-017	Unknown	PETN 1	410.82	N/A	0.0470
826	073012\Spl.wiff	K1206334-017	Unknown	PETN 2	0.0000	N/A	No Peak
827	073012\Spl.wiff	K1206334-017	Unknown	RDX 1	10023.	N/A	0.347



COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Filter	**Date Received:**	NA
Sample Name:	Method Blank	**Units:**	ng/Sample
Lab Code:	KQ1207704-03	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	100	25	1	7/ 6/12	7/31/12 04:01	161950	302794	
RDX	ND	U	100	18	1	7/ 6/12	7/31/12 04:01	161950	302794	
1,3,5-Trinitrobenzene	ND	U	100	28	1	7/ 6/12	7/31/12 04:01	161950	302794	
1,3-Dinitrobenzene	ND	U	100	62	1	7/ 6/12	7/31/12 04:01	161950	302794	
Tetryl	ND	U	100	18	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	100	11	1	7/ 6/12	7/31/12 04:01	161950	302794	
4-Amino-2,6-dinitrotoluene	ND	U	100	16	1	7/ 6/12	7/31/12 04:01	161950	302794	
2-Amino-4,6-dinitrotoluene	ND	U	100	9.0	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,4-Dinitrotoluene	ND	U	120	120	1	7/ 6/12	7/31/12 04:01	161950	302794	
2,6-Dinitrotoluene	ND	U	100	69	1	7/ 6/12	7/31/12 04:01	161950	302794	
3,5-Dinitroaniline	ND	U	100	12	1	7/ 6/12	7/31/12 04:01	161950	302794	
PETN	ND	U	100	20	1	7/ 6/12	7/31/12 04:01	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	73	70-130	7/31/12 04:01	
1,3-Dinitrobenzene-C13	91	70-130	7/31/12 04:01	

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

MB

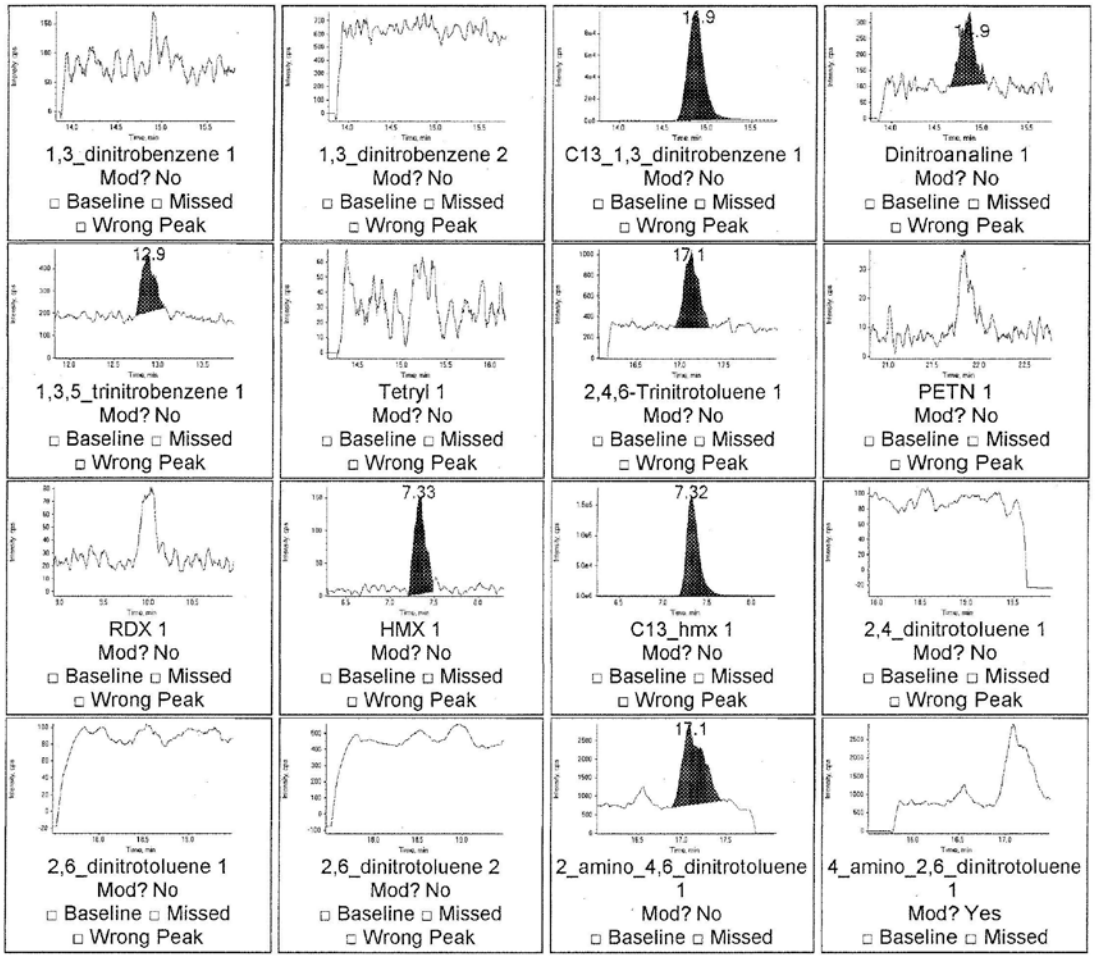
Sample Name	KQ1207704-03	**Injection Volume**	100
Acquisition Date	7/31/2012 4:01:26 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	30	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1251800	45.30	No
Dinitroanaline 1	14.90 (14.80)	2278	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	2671	0.09	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	8354	N/A	No
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	0.00 (9.93)	0	N/A	No
HMX 1	7.33 (7.28)	1403	0.17	No
C13_hmx 1	7.32 (7.25)	1597800	36.60	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	35058	0.07	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	Yes

8/2/12

Quantitative Peak Review KQ1207704-03



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Filter	**Date Received:**	NA
Sample Name:	Lab Control Sample	**Units:**	ng/Sample
Lab Code:	KQ1207704-01	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**3820**		100	25	1	7/ 6/12	7/31/12 03:08	161950	302794	
RDX	**3700**		100	18	1	7/ 6/12	7/31/12 03:08	161950	302794	
1,3,5-Trinitrobenzene	**4370**		100	28	1	7/ 6/12	7/31/12 03:08	161950	302794	
1,3-Dinitrobenzene	**5070**		100	62	1	7/ 6/12	7/31/12 03:08	161950	302794	
Tetryl	**3560**		100	18	1	7/ 6/12	7/31/12 03:08	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**4380**		100	11	1	7/ 6/12	7/31/12 03:08	161950	302794	
4-Amino-2,6-dinitrotoluene	**4350**		100	16	1	7/ 6/12	7/31/12 03:08	161950	302794	
2-Amino-4,6-dinitrotoluene	**4170**		100	9.0	1	7/ 6/12	7/31/12 03:08	161950	302794	
2,4-Dinitrotoluene	**4840**		120	120	1	7/ 6/12	7/31/12 03:08	161950	302794	
2,6-Dinitrotoluene	**5710**		100	69	1	7/ 6/12	7/31/12 03:08	161950	302794	
3,5-Dinitroaniline	**4280**		100	12	1	7/ 6/12	7/31/12 03:08	161950	302794	
PETN	**4400**		100	20	1	7/ 6/12	7/31/12 03:08	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	84	70-130	7/31/12 03:08	
1,3-Dinitrobenzene-C13	96	70-130	7/31/12 03:08	

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

LCS

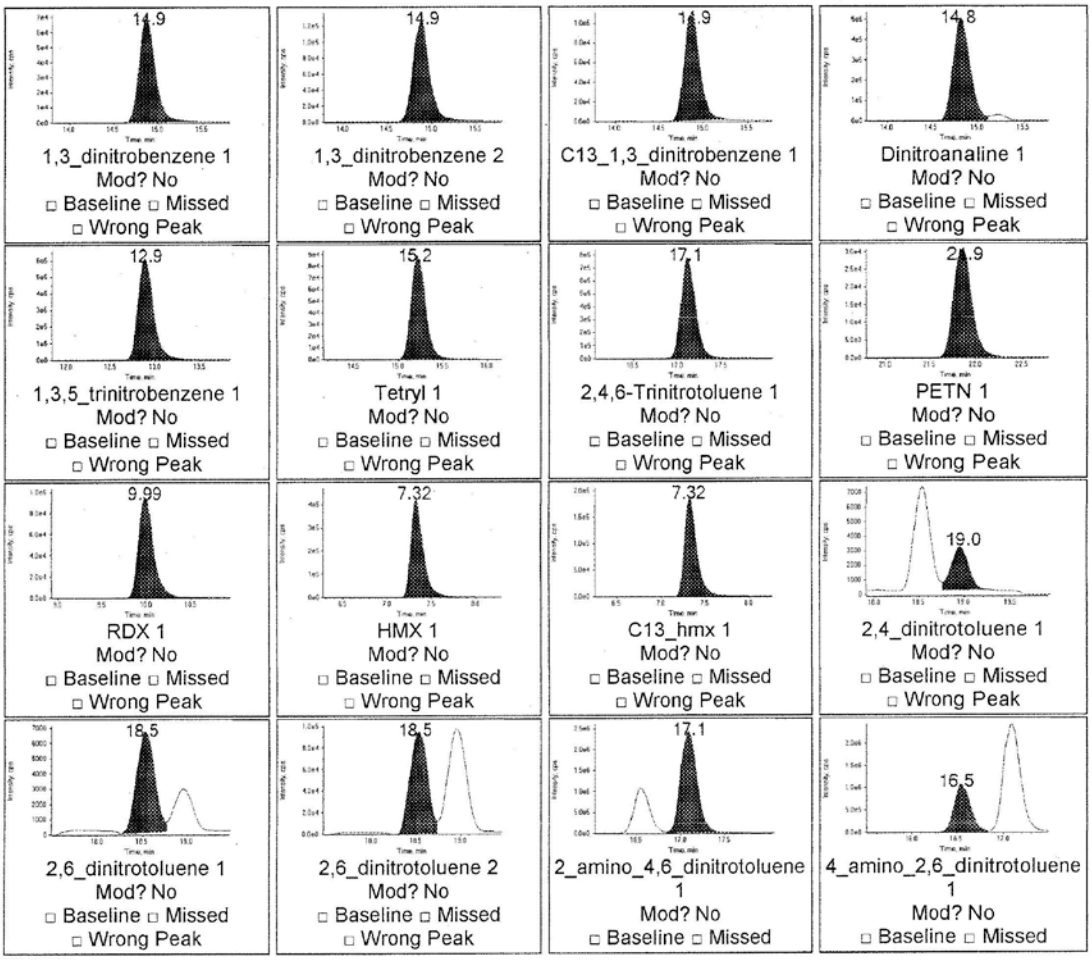
Sample Name	KQ1207704-01	**Injection Volume**	100
Acquisition Date	7/31/2012 3:08:07 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	28	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	879430	50.70	No
1,3_dinitrobenzene 2	14.90 (14.80)	1642900	49.80	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1330500	48.10	No
Dinitroanaline 1	14.80 (14.80)	6271600	42.80	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	7485100	43.70	No
Tetryl 1	15.20 (15.20)	1007200	35.60	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	8982700	43.80	No
PETN 1	21.90 (21.80)	416640	44.00	No
RDX 1	9.99 (9.93)	1138600	37.00	No
HMX 1	7.32 (7.28)	4130200	38.20	No
C13_hmx 1	7.32 (7.25)	1837900	41.90	No
2,4_dinitrotoluene 1	19.00 (18.90)	39005	48.40	No
2,6_dinitrotoluene 1	18.50 (18.50)	95369	57.10	No
2,6_dinitrotoluene 2	18.50 (18.50)	1319700	57.70	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	31817000	41.70	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	13127000	43.50	No

8/2/12

Quantitative Peak Review KQ1207704-01



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206334
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Filter	**Date Received:**	NA
Sample Name:	Duplicate Lab Control Sample	**Units:**	ng/Sample
Lab Code:	KQ1207704-02	**Basis:**	As Received

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**3470**		100	25	1	7/ 6/12	7/31/12 03:34	161950	302794	
RDX	**3410**		100	18	1	7/ 6/12	7/31/12 03:34	161950	302794	
1,3,5-Trinitrobenzene	**3870**		100	28	1	7/ 6/12	7/31/12 03:34	161950	302794	
1,3-Dinitrobenzene	**4840**		100	62	1	7/ 6/12	7/31/12 03:34	161950	302794	
Tetryl	**3260**		100	18	1	7/ 6/12	7/31/12 03:34	161950	302794	
2,4,6-Trinitrotoluene (TNT)	**4180**		100	11	1	7/ 6/12	7/31/12 03:34	161950	302794	
4-Amino-2,6-dinitrotoluene	**4220**		100	16	1	7/ 6/12	7/31/12 03:34	161950	302794	
2-Amino-4,6-dinitrotoluene	**4010**		100	9.0	1	7/ 6/12	7/31/12 03:34	161950	302794	
2,4-Dinitrotoluene	**4240**		120	120	1	7/ 6/12	7/31/12 03:34	161950	302794	
2,6-Dinitrotoluene	**4970**		100	69	1	7/ 6/12	7/31/12 03:34	161950	302794	
3,5-Dinitroaniline	**4040**		100	12	1	7/ 6/12	7/31/12 03:34	161950	302794	
PETN	**4060**		100	20	1	7/ 6/12	7/31/12 03:34	161950	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	78	70-130	7/31/12 03:34	
1,3-Dinitrobenzene-C13	94	70-130	7/31/12 03:34	

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

DLCS

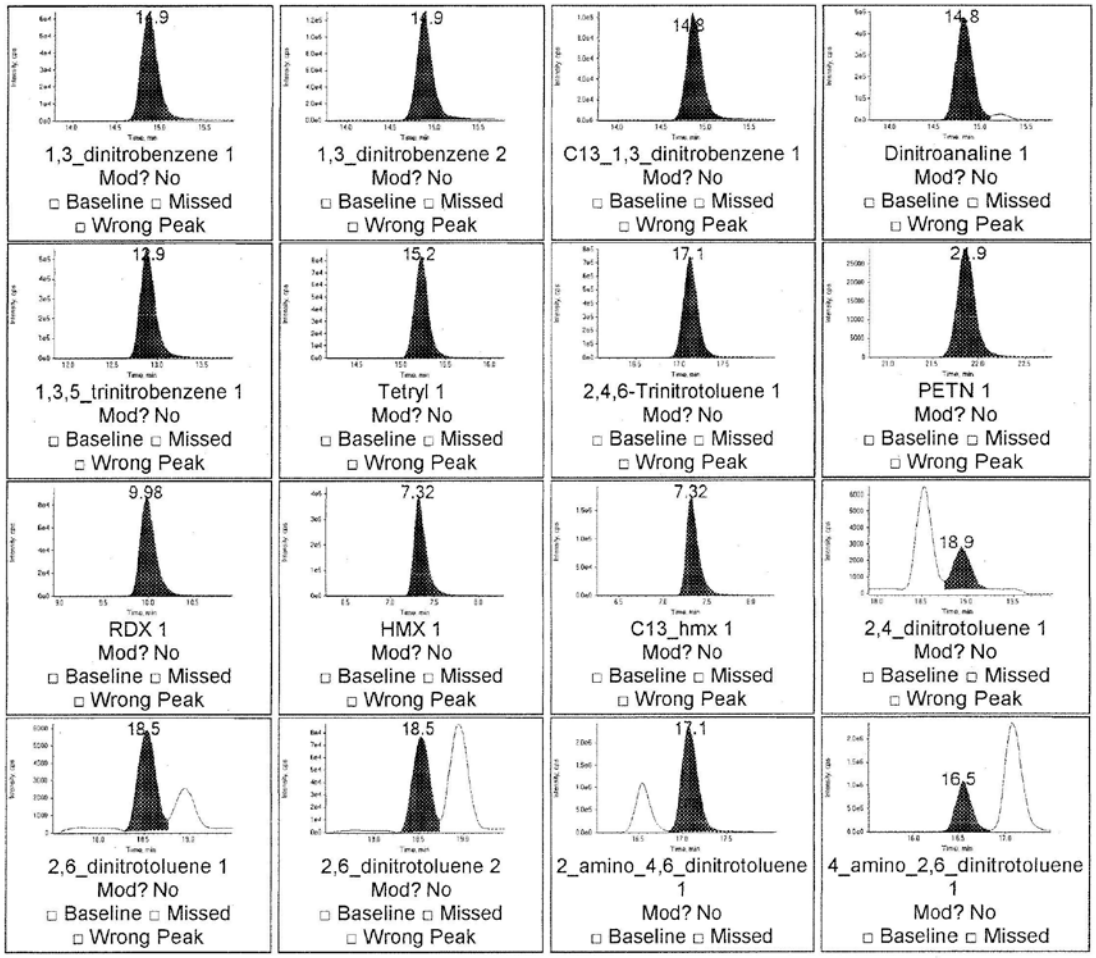
Sample Name	KQ1207704-02	**Injection Volume**	100
Acquisition Date	7/31/2012 3:34:46 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	29	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	838500	48.40	No
1,3_dinitrobenzene 2	14.90 (14.80)	1600000	48.60	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1295900	46.90	No
Dinitroanaline 1	14.80 (14.80)	5927700	40.40	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	6639900	38.70	No
Tetryl 1	15.20 (15.20)	920790	32.60	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	8565400	41.80	No
PETN 1	21.90 (21.80)	383320	40.50	No
RDX 1	9.98 (9.93)	1047000	34.10	No
HMX 1	7.32 (7.28)	3748600	34.70	No
C13_hmx 1	7.32 (7.25)	1696500	38.80	No
2,4_dinitrotoluene 1	18.90 (18.90)	34109	42.40	No
2,6_dinitrotoluene 1	18.50 (18.50)	82051	49.70	No
2,6_dinitrotoluene 2	18.50 (18.50)	1071600	47.50	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	30692000	40.10	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	12764000	42.20	No

MH 8/10/12 8/2/12

Quantitative Peak Review KQ1207704-02



☐ Before ☐ After

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Standards Data

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date	#	File Location	Acquisition Date
02	073012\Calib.wiff	7/30/12 14:41	03	073012\Calib.wiff	7/30/12 15:08
04	073012\Calib.wiff	7/30/12 15:35	05	073012\Calib.wiff	7/30/12 16:01
06	073012\Calib.wiff	7/30/12 16:28	07	073012\Calib.wiff	7/30/12 16:54
08	073012\Calib.wiff	7/30/12 17:21			

Analyte

HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	9.404E4	03	2.00	9.609E4	04	5.00	9.957E4	05	10.0	1.112E5
06	50.0	1.078E5	07	100.	1.100E5	08	200.	1.127E5			

RDX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.985E4	03	2.00	2.908E4	04	5.00	3.004E4	05	10.0	3.156E4
06	50.0	3.169E4	07	100.	3.084E4	08	200.	3.290E4			

1,3,5-Trinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.481E5	03	2.00	1.595E5	04	5.00	1.760E5	05	10.0	1.810E5
06	50.0	1.817E5	07	100.	1.611E5	08	200.	1.714E5			

1,3-Dinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.706E4	03	2.00	1.905E4	04	5.00	1.746E4	05	10.0	1.751E4
06	50.0	1.708E4	07	100.	1.799E4	08	200.	1.907E4			

Tetryl

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.763E4	03	2.00	2.899E4	04	5.00	2.936E4	05	10.0	3.046E4
06	50.0	2.735E4	07	100.	2.946E4	08	200.	3.037E4			

2,4,6-Trinitrotoluene (TNT)

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.992E5	03	2.00	2.092E5	04	5.00	2.237E5	05	10.0	2.148E5
06	50.0	2.052E5	07	100.	2.040E5	08	200.	2.117E5			

4-Amino-2,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.915E5	03	2.00	2.980E5	04	5.00	3.193E5	05	10.0	3.262E5
06	50.0	3.068E5	07	100.	2.846E5	08	200.	2.783E5			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

Analyte

2-Amino-4,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	7.461E5	03	2.00	7.928E5	04	5.00	8.506E5	05	10.0	8.428E5
06	50.0	7.692E5	07	100.	6.518E5	08	200.	5.264E5			

2,4-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	605.0	03	2.00	658.5	04	5.00	739.5	05	10.0	723.6
06	50.0	805.2	07	100.	751.6	08	200.	841.6			

2,6-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1,363	03	2.00	1,273	04	5.00	1,660	05	10.0	1,684
06	50.0	1,790	07	100.	1,647	08	200.	2,073			

3,5-Dinitroaniline

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.309E5	03	2.00	1.400E5	04	5.00	1.435E5	05	10.0	1.510E5
06	50.0	1.481E5	07	100.	1.438E5	08	200.	1.442E5			

PETN

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	8,939	03	2.00	8,985	04	5.00	9,398	05	10.0	9,423
06	50.0	9,636	07	100.	9,745	08	200.	1.061E4			

C13-HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	3.753E4	03	2.00	3.852E4	04	5.00	3.957E4	05	10.0	4.467E4
06	50.0	4.414E4	07	100.	4.577E4	08	200.	4.968E4			

1,3-Dinitrobenzene-C13

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.720E4	03	2.00	2.944E4	04	5.00	2.628E4	05	10.0	2.853E4
06	50.0	2.809E4	07	100.	2.835E4	08	200.	3.124E4			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

		Calibration Evaluation					RRF Evaluation		
Analyte Name	**Compound Type**	**Fit Type**	**Eval.**	**Eval. Result**	**Q**	**Control Criteria**	**Average RRF**	**Q**	**Minimum RRF**
HMX	TRG	Quadratic	COD	1.000		≥0.990	NA		
RDX	TRG	Quadratic	COD	1.000		≥0.990	NA		
1,3,5-Trinitrobenzene	TRG	Quadratic	COD	0.998		≥0.990	NA		
1,3-Dinitrobenzene	TRG	Quadratic	COD	1.000		≥0.990	NA		
Tetryl	TRG	Quadratic	COD	1.000		≥0.990	NA		
2,4,6-Trinitrotoluene (TNT)	TRG	Quadratic	COD	1.000		≥0.990	NA		
4-Amino-2,6-dinitrotoluene	TRG	Quadratic	COD	1.000		≥0.990	NA		
2-Amino-4,6-dinitrotoluene	TRG	Quadratic	COD	0.999		≥0.990	NA		
2,4-Dinitrotoluene	TRG	Linear	R2	0.997		≥0.990	NA		
2,6-Dinitrotoluene	TRG	Quadratic	COD	0.998		≥0.990	NA		
3,5-Dinitroaniline	TRG	Quadratic	COD	1.000		≥0.990	NA		
PETN	TRG	Quadratic	COD	1.000		≥0.990	NA		
C13-HMX	SURR	Quadratic	COD	1.000		≥0.990	NA		
1,3-Dinitrobenzene-C13	SURR	Quadratic	COD	1.000		≥0.990	NA		

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Calibration Date: 7/30/12

Initial Calibration Verfication Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date
40	073012\Calib.wiff	7/30/12 18:41

Analyte Name	Expected	Result	Average RF	SSV RF	%D	Criteria	Curve Fit
HMX	100.	112.780	1.045E5	1.244E5	12.78	±30	Quadratic
RDX	100.	109.539	3.085E4	3.469E4	9.54	±30	Quadratic
1,3,5-Trinitrobenzene	100.	113.984	1.684E5	1.945E5	13.98	±30	Quadratic
1,3-Dinitrobenzene	100.	125.197	1.789E4	2.279E4	25.20	±30	Quadratic
Tetryl	100.	121.625	2.909E4	3.573E4	21.63	±30	Quadratic
2,4,6-Trinitrotoluene (TNT)	100.	122.828	2.097E5	2.554E5	22.83	±30	Quadratic
4-Amino-2,6-dinitrotoluene	100.	114.681	3.007E5	3.331E5	14.68	±30	Quadratic
2-Amino-4,6-dinitrotoluene	100.	118.245	7.400E5	7.645E5	18.24	±30	Quadratic
2,4-Dinitrotoluene	100.	112.377	732.1	909.2	12.38	±30	Linear
2,6-Dinitrotoluene	100.	117.310	1,641	2,146	17.31	±30	Quadratic
3,5-Dinitroaniline	100.	112.234	1.431E5	1.633E5	12.23	±30	Quadratic
PETN	100.	111.426	9,534	1.109E4	11.43	±30	Quadratic
C13-HMX	100.	105.792	4.284E4	4.890E4	5.79	±30	Quadratic
1,3-Dinitrobenzene-C13	100.	116.671	2.845E4	3.410E4	16.67	±30	Quadratic

Date: 7/30/12

Columbia Analytical Services, Inc.

Injection Log

LCMS02 - API 5000

ICAL Date: 7/30/12

ICAL ID: KC1200067

LIMS ID: 302794

By: dhaderly # 8/1/12

2nd Review: MH 8/10/12

Column: phenomenex Synergi: 4µ Hydro-RP 80A 250 x 2.0 mm 4µ S/N 599693-2

Mobile Phases A: 5mM NH_4OAc H_2O EFS 8/1/12 B: 8:2 MeOH : ACN EFS 8/1/12

Project Folder: D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012

	Sample Name	File Name	Acquisition Method	Dilution	R	Comments
1	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
2	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
3	Explosives 1ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
4	Explosives 2ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
5	Explosives 5ppb ←	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
6	Explosives 10ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
7	Explosives 50ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
8	Explosives 100ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
9	Explosives 200ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
10	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
11	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	6:25 pm
12	Explosives 100ppb ICV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	6:41 pm
13	K1206334-001	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
14	K1206334-002	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
15	K1206334-003	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
16	K1206334-004	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
17	K1206334-005	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
18	K1206334-006	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
19	K1206334-007	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
20	K1206334-008	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
21	K1206334-009	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
22	K1206334-010	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
23	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	11:34 pm
24	K1206334-011	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
25	K1206334-012	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
26	K1206334-013	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
27	K1206334-014	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
28	K1206334-015	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
29	K1206334-016	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
30	K1206334-017	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	

Date: 7/30/12

Columbia Analytical Services, Inc.

Injection Log

LCMS02 - API 5000

ICAL Date: 7/30/12

By: dhaderly

ICAL ID:

2nd Review: MH 8/16/12

LIMS ID: 302794

Column: See Pg. 1

Mobile Phases A: B:

Project Folder: D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012

	Sample Name	File Name	Acquisition Method	Dilution	R	Comments
1	KQ1207704-01	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
2	KQ1207704-02	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
3	KQ1207704-03	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
4	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	x	428am
5	K1206333-001	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
6	K1206333-002	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
7	K1206333-003	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
8	K1206333-004	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
9	K1206333-005	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
10	KQ1207790-01	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
11	KQ1207790-02	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
12	KQ1207790-03	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
13	KQ1207790-04	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
14	KQ1207790-05	073012\Spl.wiff	Explosives_SchMRM_2012	1	x	
15	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	x	9:21
16						
17						
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19						
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23			MH 8/10/12			
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29						
30						

D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012\INJLOG_LCMS02.XLS

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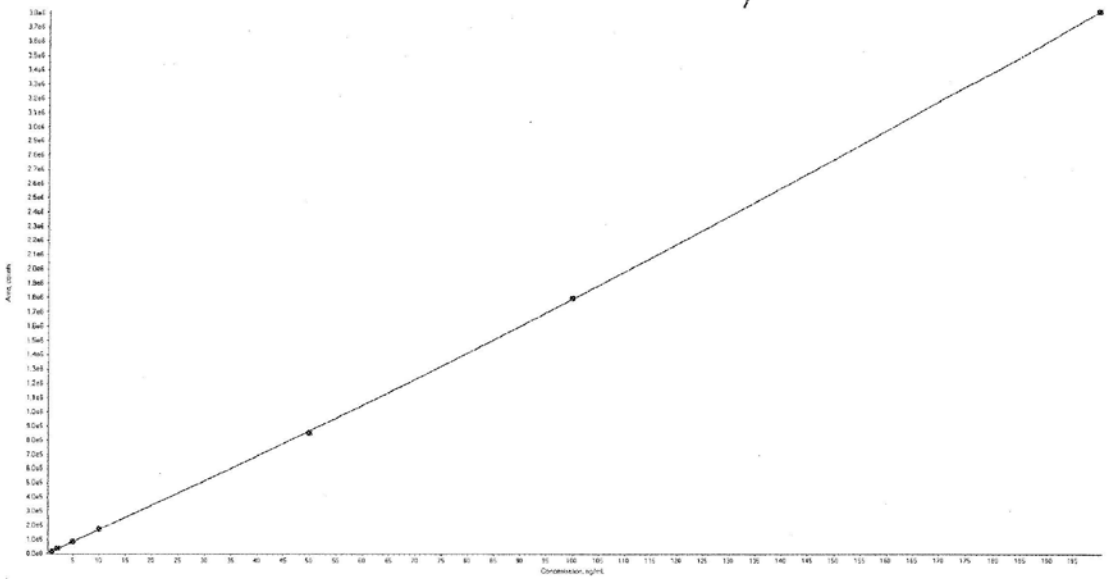
Printed: 8/2/2012 7:45 AM

Analyte Name: 1,3_dinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 11.7 x^2 + 1.67e+004 x + 2.1e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.89	89	NaN	NaN
2	1	2.15	107	NaN	NaN
5	1	5.08	102	NaN	NaN
10	1	10.27	103	NaN	NaN
50	1	49.24	98	NaN	NaN
100	1	100.40	100	NaN	NaN
200	1	199.97	100	NaN	NaN



8/2/12

8/10/11

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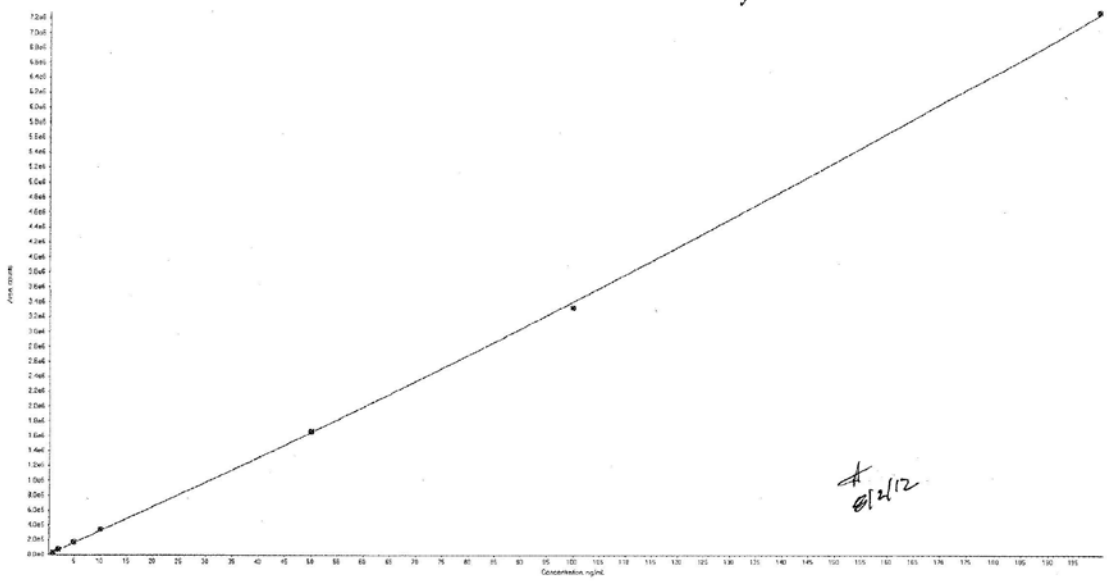
Printed: 8/2/2012 7:45 AM

Analyte Name: 1,3_dinitrobenzene 2
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 22.1 x^2 + 3.18e+004 x + 3.12e+003 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.79	79	NaN	NaN
2	1	2.22	111	NaN	NaN
5	1	5.22	104	NaN	NaN
10	1	10.62	106	NaN	NaN
50	1	50.47	101	NaN	NaN
100	1	97.88	98	NaN	NaN
200	1	200.81	100	NaN	NaN



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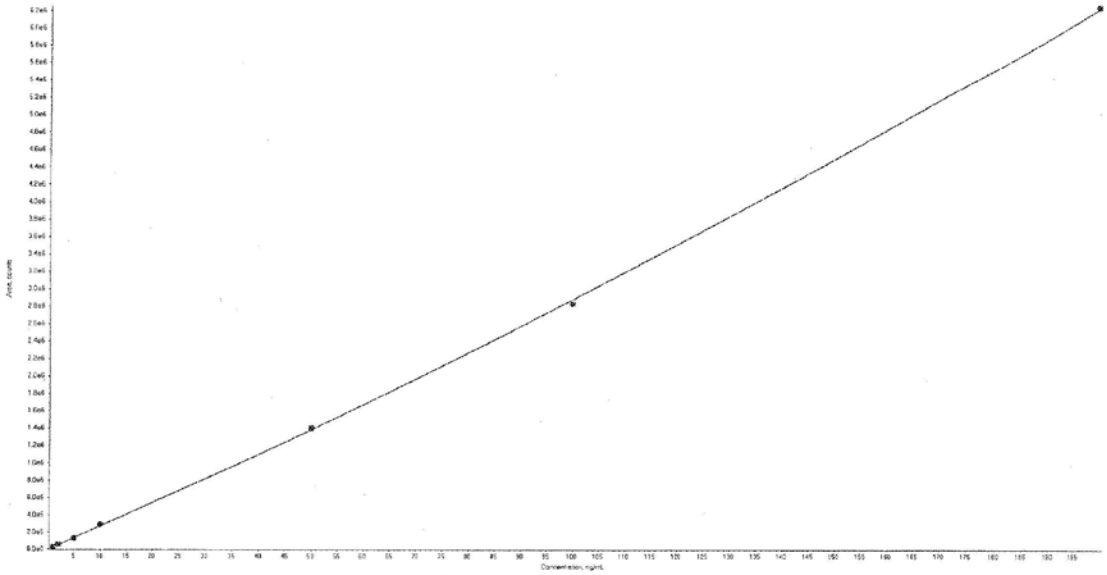
Analyte Name: C13_1,3_dinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 23.1 x^2 + 2.65e+004 x + 2.77e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.92	92	NaN	NaN
2	1	2.11	106	NaN	NaN
5	1	4.83	97	NaN	NaN
10	1	10.56	106	NaN	NaN
50	1	50.65	101	NaN	NaN
100	1	98.39	98	NaN	NaN
200	1	200.55	100	NaN	NaN



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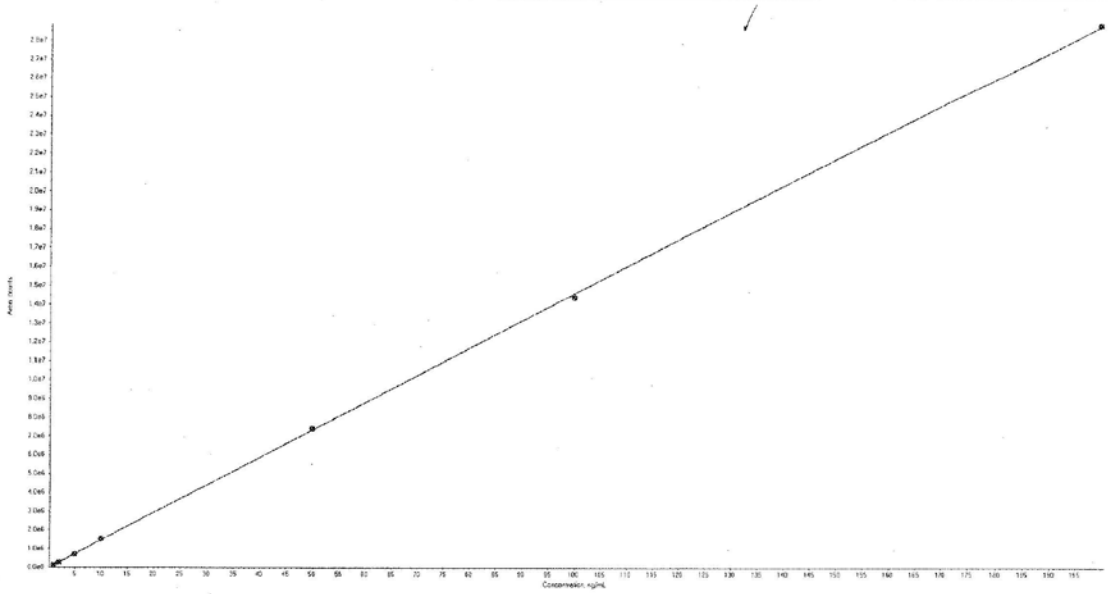
Analyte Name: Dinitroanaline 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -19.3 x^2 + 1.48e+005 x + -1.41e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.98	98	NaN	NaN
2	1	1.99	100	NaN	NaN
5	1	4.95	99	NaN	NaN
10	1	10.33	103	NaN	NaN
50	1	50.54	101	NaN	NaN
100	1	98.70	99	NaN	NaN
200	1	200.51	100	NaN	NaN



8/2/12

Columbia Analytical Services

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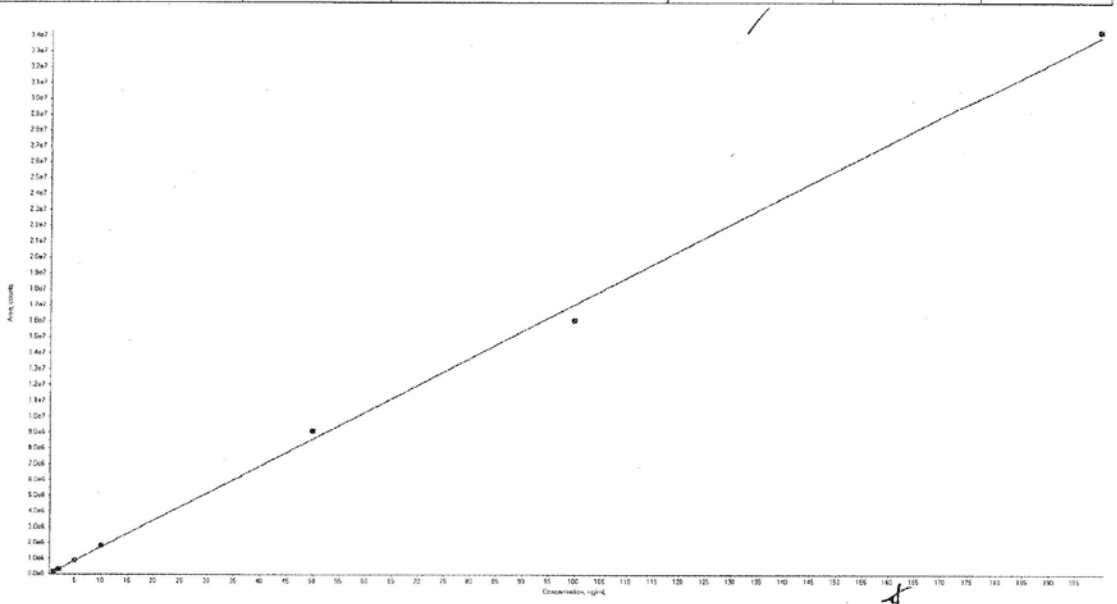
Analyte Name: 1,3,5_trinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -12.6 x^2 + 1.72e+005 x + -1.21e+004 (r = 0.9991)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.93	93	NaN	NaN
2	1	1.92	96	NaN	NaN
5	1	5.18	104	NaN	NaN
10	1	10.59	106	NaN	NaN
50	1	53.02	106	NaN	NaN
100	1	94.24	94	NaN	NaN
200	1	202.12	101	NaN	NaN



8/2/12

MR 8/10/12

Columbia Analytical Services

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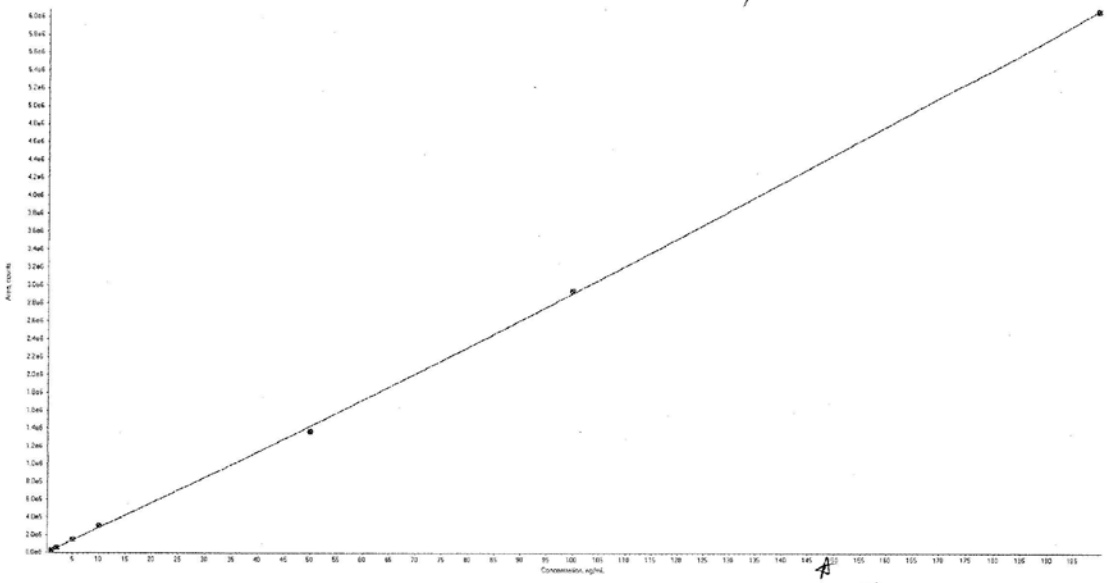
Analyte Name: Tetryl 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 13 x^2 + 2.78e+004 x + 2.39e+003 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.91	91	NaN	NaN
2	1	2.00	100	NaN	NaN
5	1	5.19	104	NaN	NaN
10	1	10.83	108	NaN	NaN
50	1	48.06	96	NaN	NaN
100	1	101.17	101	NaN	NaN
200	1	199.85	100	NaN	NaN



8/2/12

8/10/12

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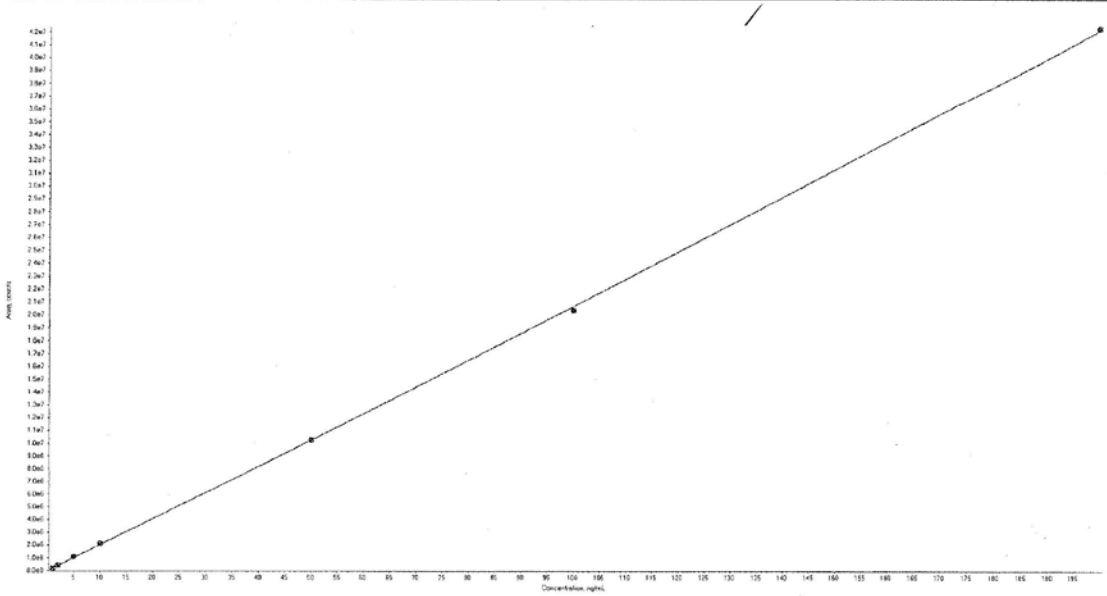
Analyte Name: 2,4,6-Trinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 40.3 x^2 + 2.03e+005 x + 1.81e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.89	89	NaN	NaN
2	1	1.97	99	NaN	NaN
5	1	5.42	108	NaN	NaN
10	1	10.48	105	NaN	NaN
50	1	50.01	100	NaN	NaN
100	1	98.58	99	NaN	NaN
200	1	200.65	100	NaN	NaN



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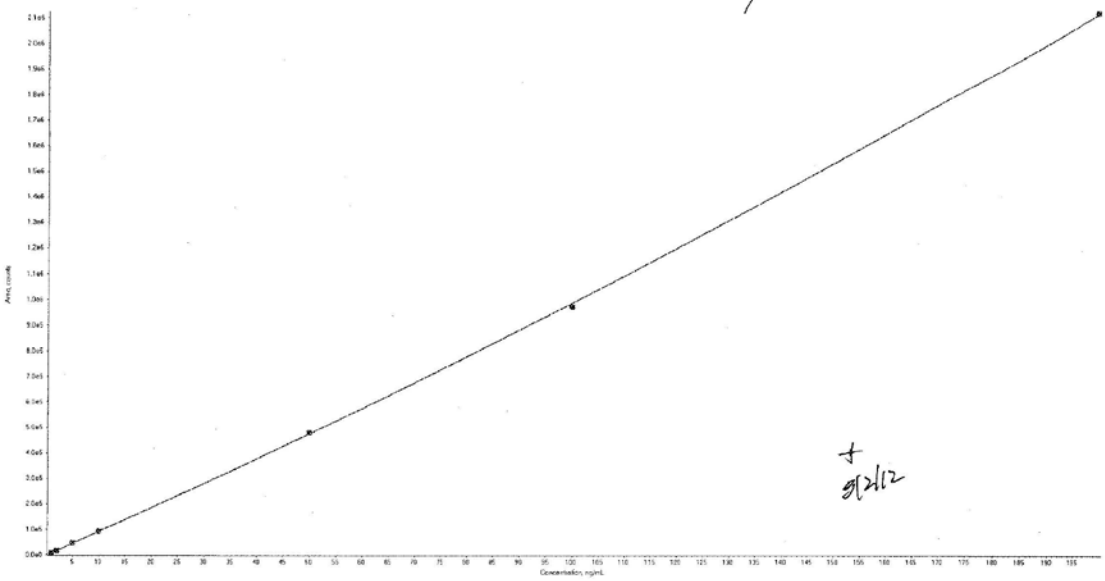
Analyte Name: PETN 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 7.1 x^2 + 9.17e+003 x + -20.1 (r = 1.0000)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.98	98	NaN	NaN
2	1	1.96	98	NaN	NaN
5	1	5.11	102	NaN	NaN
10	1	10.20	102	NaN	NaN
50	1	50.59	101	NaN	NaN
100	1	98.76	99	NaN	NaN
200	1	200.41	100	NaN	NaN



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8/2/12

MH Shoe

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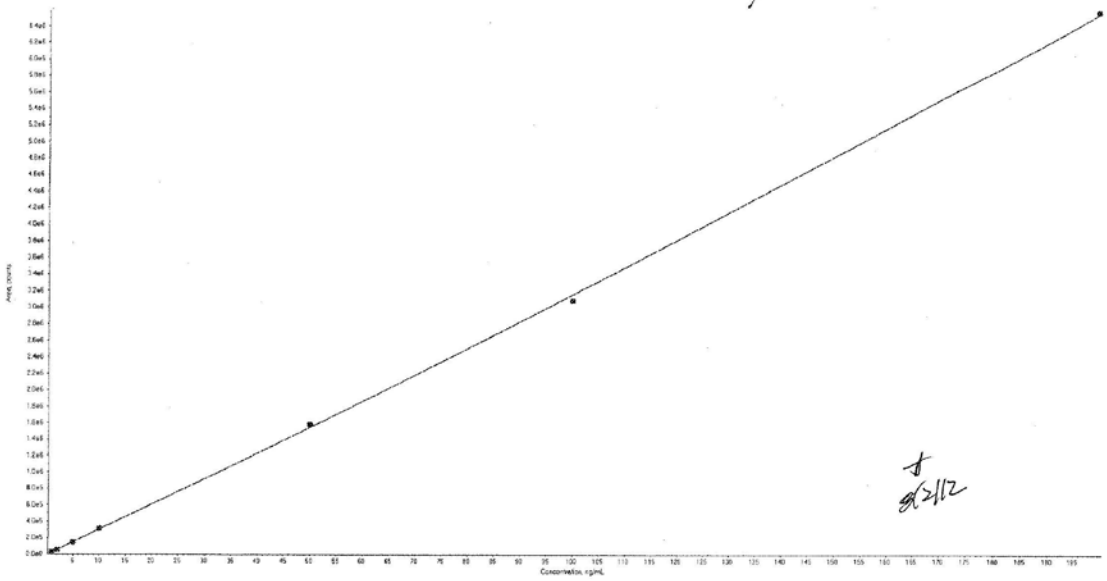
Analyte Name: RDX 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 12.1 x^2 + 3.03e+004 x + -500 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.00	100	NaN	NaN
2	1	1.93	97	NaN	NaN
5	1	4.96	99	NaN	NaN
10	1	10.37	104	NaN	NaN
50	1	51.19	102	NaN	NaN
100	1	97.82	98	NaN	NaN
200	1	200.73	100	NaN	NaN



8/2/12

8/10/12

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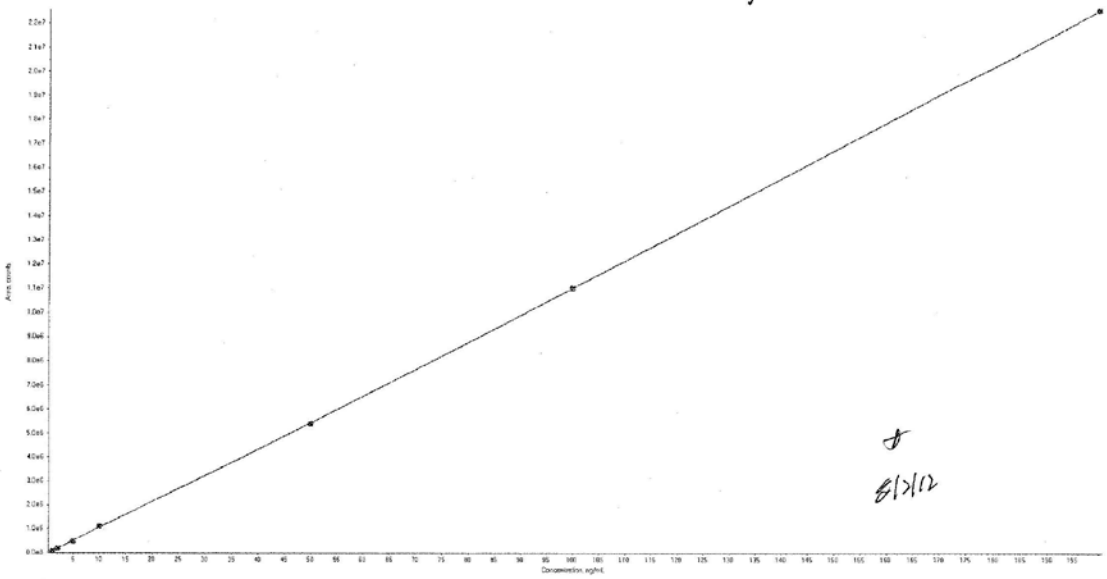
Printed: 8/2/2012 7:45 AM

Analyte Name: HMX 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 26.6 x^2 + 1.07e+005 x + -1.67e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.03	103	NaN	NaN
2	1	1.94	97	NaN	NaN
5	1	4.78	96	NaN	NaN
10	1	10.48	105	NaN	NaN
50	1	49.71	99	NaN	NaN
100	1	100.02	100	NaN	NaN
200	1	200.04	100	NaN	NaN



8/2/12

8/10/12

Columbia Analytical Services

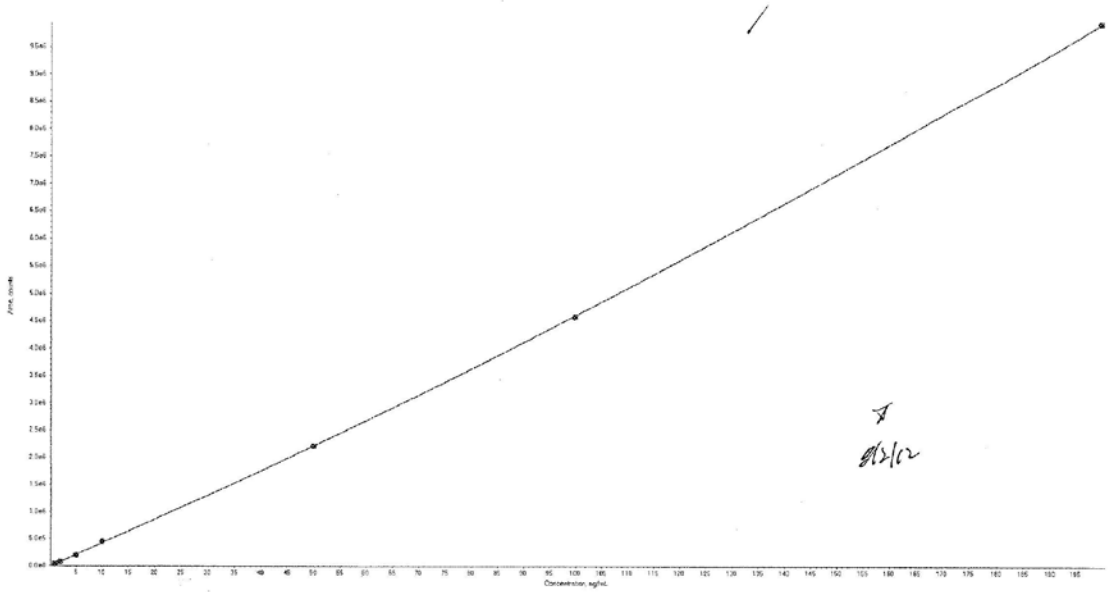
Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Analyte Name: C13_hmx 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 35.9 x^2 + 4.25e+004 x + -5.8e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.02	102	NaN	NaN
2	1	1.95	97	NaN	NaN
5	1	4.78	96	NaN	NaN
10	1	10.56	106	NaN	NaN
50	1	49.99	100	NaN	NaN
100	1	99.53	100	NaN	NaN
200	1	200.19	100	NaN	NaN



8/3/12

8/10/12

Columbia Analytical Services

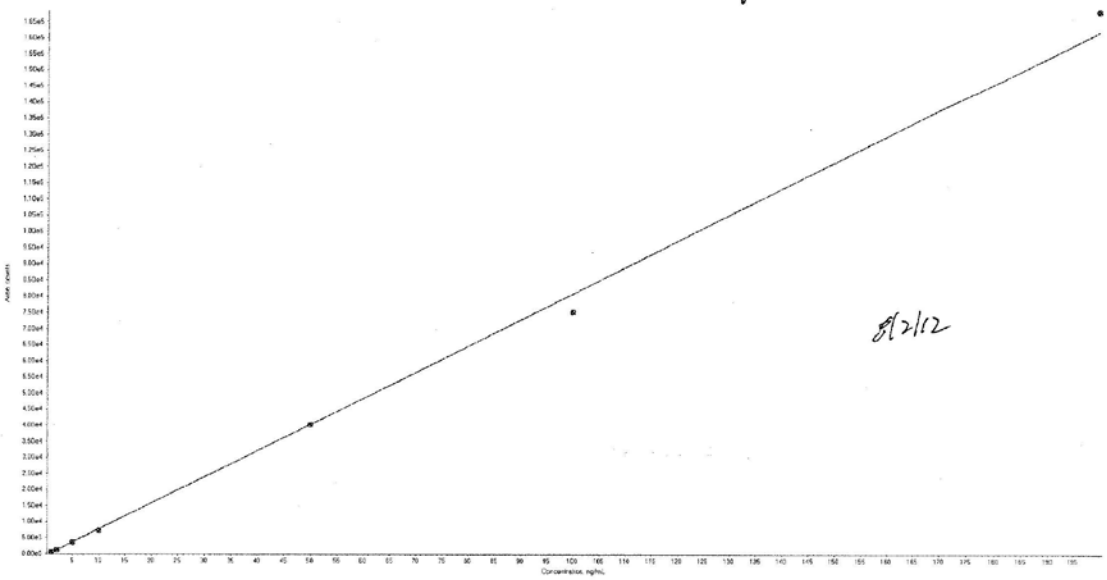
Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Analyte Name: 2,4_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 812 x + -304 (r = 0.9987)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.12	112	NaN	NaN
2	1	2.00	100	NaN	NaN
5	1	4.93	99	NaN	NaN
10	1	9.29	93	NaN	NaN
50	1	49.97	100	NaN	NaN
100	1	92.97	93	NaN	NaN
200	1	207.73	104	NaN	NaN



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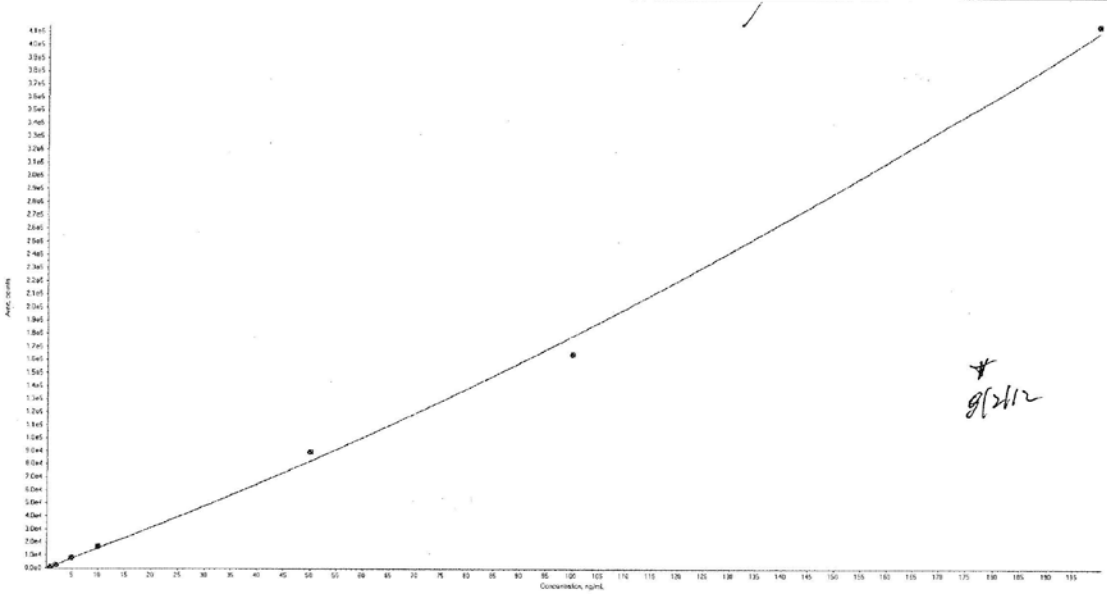
Analyte Name: 2,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 2.65 x^2 + 1.52e+003 x + -64.2 (r = 0.9987)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.71	86	NaN	NaN
5	1	5.46	109	NaN	NaN
10	1	10.92	109	NaN	NaN
50	1	53.91	108	NaN	NaN
100	1	93.31	93	NaN	NaN
200	1	201.92	101	NaN	NaN



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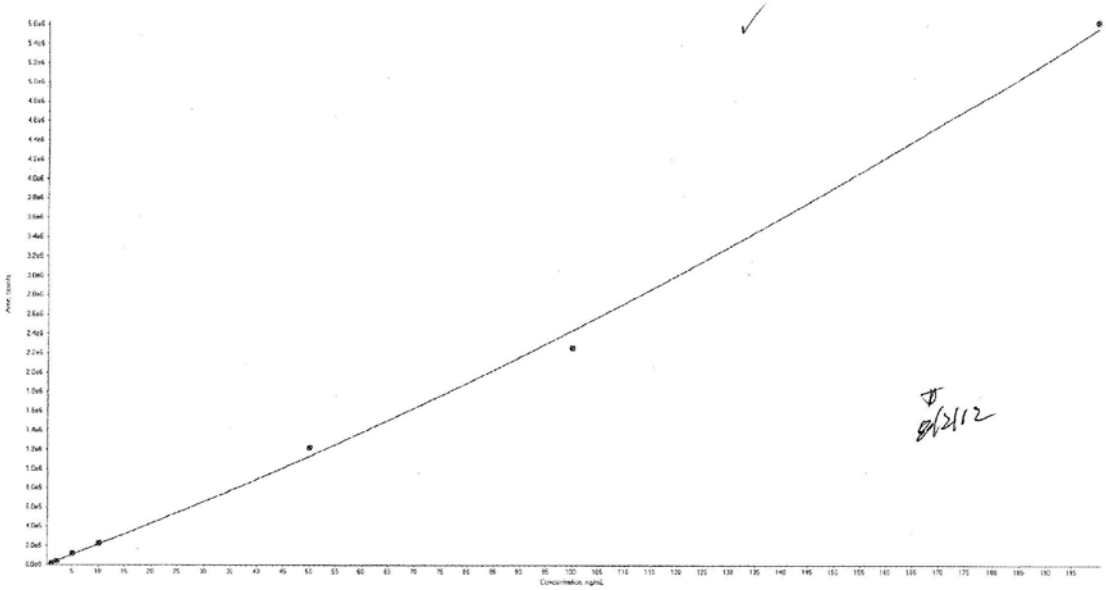
Analyte Name: 2,6_dinitrotoluene 2
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 34.8 x^2 + 2.08e+004 x + 3.4e+003 (r = 0.9988)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.83	83	NaN	NaN
2	1	1.91	96	NaN	NaN
5	1	5.61	112	NaN	NaN
10	1	10.66	107	NaN	NaN
50	1	53.74	107	NaN	NaN
100	1	93.51	94	NaN	NaN
200	1	201.89	101	NaN	NaN



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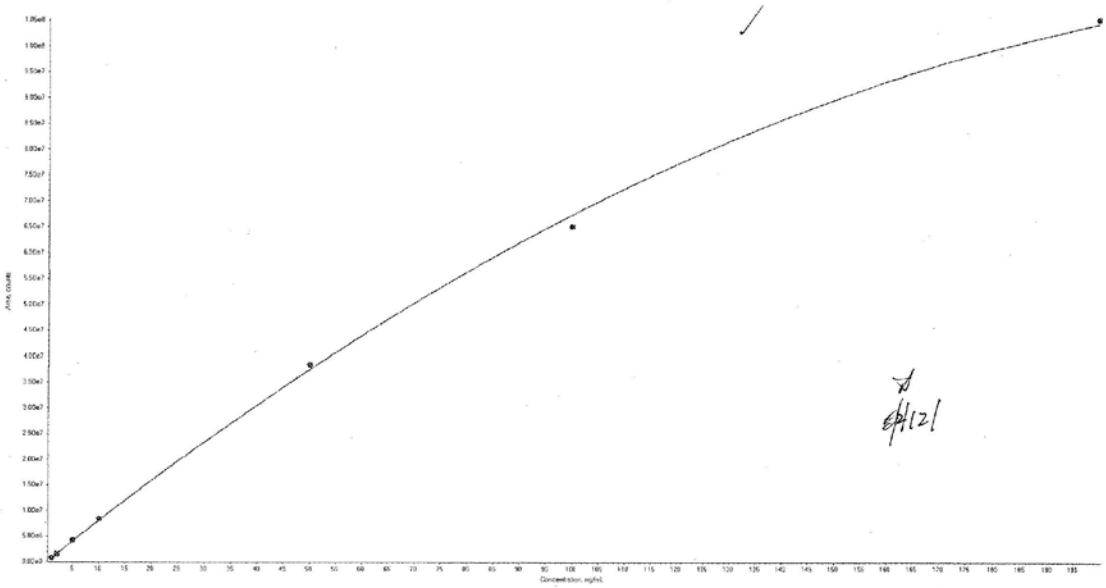
Analyte Name: 2_amino_4,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -1.52e+003 x^2 + 8.27e+005 x + -2.61e+004 (r = 0.9996)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.96	98	NaN	NaN
5	1	5.23	105	NaN	NaN
10	1	10.42	104	NaN	NaN
50	1	51.41	103	NaN	NaN
100	1	95.75	96	NaN	NaN
200	1	204.09	102	NaN	NaN



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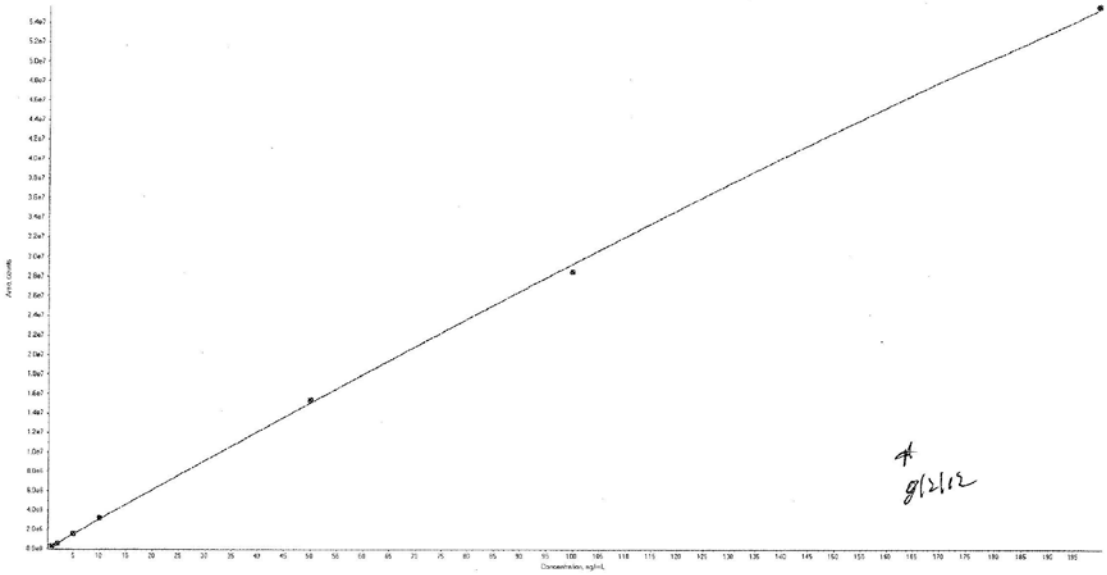
Analyte Name: 4_amino_2,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -162 x^2 + 3.09e+005 x + 606 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.93	96	NaN	NaN
5	1	5.18	104	NaN	NaN
10	1	10.61	106	NaN	NaN
50	1	51.01	102	NaN	NaN
100	1	97.02	97	NaN	NaN
200	1	201.35	101	NaN	NaN



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Project	Ewan's Projects\Explosives
Data File	073012\Calib.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	IB	**Injection Volume**	100
Acquisition Date	7/30/2012 2:15:03 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	1	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0 ✓	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0 ✓	N/A	No
C13_1,3_dinitrobenzene 1	0.00 (14.80)	0 ✓	N/A	No
Dinitroanaline 1	14.80 (14.80)	18853 <½	0.22	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	11833 <½	0.14	No
Tetryl 1	15.10 (15.20)	1269 <½	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	13477 <½	N/A	No
PETN 1	21.80 (21.80)	860 <½	0.10	No
RDX 1	9.90 (9.93)	3271 <½	0.12	No
HMX 1	7.29 (7.28)	10511 <½	0.25	No
C13_hmx 1	0.00 (7.25)	0	N/A	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	75594 <½	0.12	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	26674 <½	0.08	No

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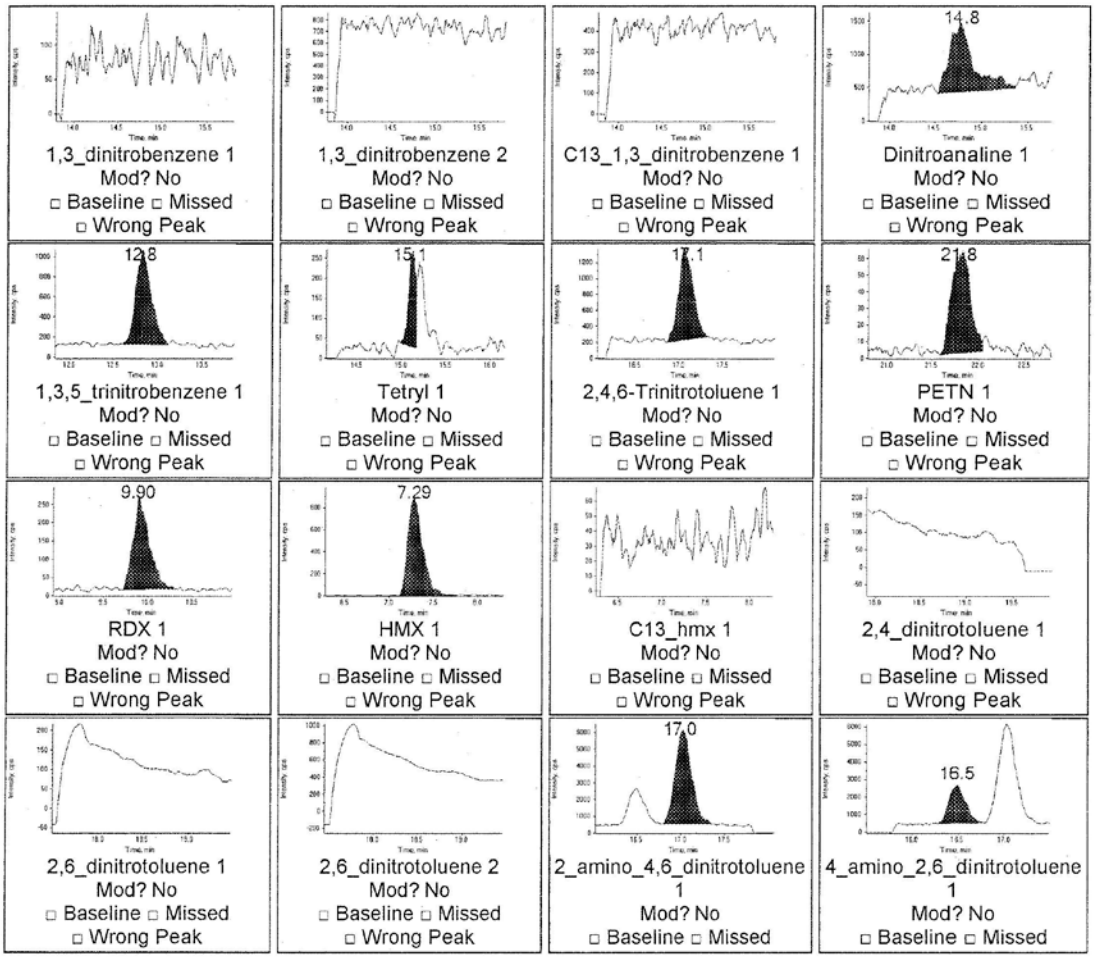
Quantitative Peak Review IB



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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 1ppb	**Injection Vial**	2
Acquisition Date	7/30/2012 2:41:42 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23B	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	17061	1.00	0.89	89	No
1,3_dinitrobenzene 2	14.80 (14.80)	28345	1.00	0.79	79	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	27198	1.00	0.92	92	No
Dinitroanaline 1	14.80 (14.80)	130880	1.00	0.98	98	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	148070	1.00	0.93	93	No
Tetryl 1	15.20 (15.20)	27634	1.00	0.91	91	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	199170	1.00	0.89	89	No
PETN 1	21.80 (21.80)	8939	1.00	0.98	98	No
RDX 1	9.91 (9.93)	29847	1.00	1.00	100	No
HMX 1	7.28 (7.28)	94041	1.00	1.03	103	No
C13_hmx 1	7.28 (7.25)	37528	1.00	1.02	102	No
2,4_dinitrotoluene 1	18.90 (18.90)	605	1.00	1.12	112	No
2,6_dinitrotoluene 1	18.50 (18.50)	1363	1.00	0.94	94	No
2,6_dinitrotoluene 2	18.50 (18.50)	20812	1.00	0.84	84	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	746120	1.00	0.94	94	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	291540	1.00	0.94	94	No

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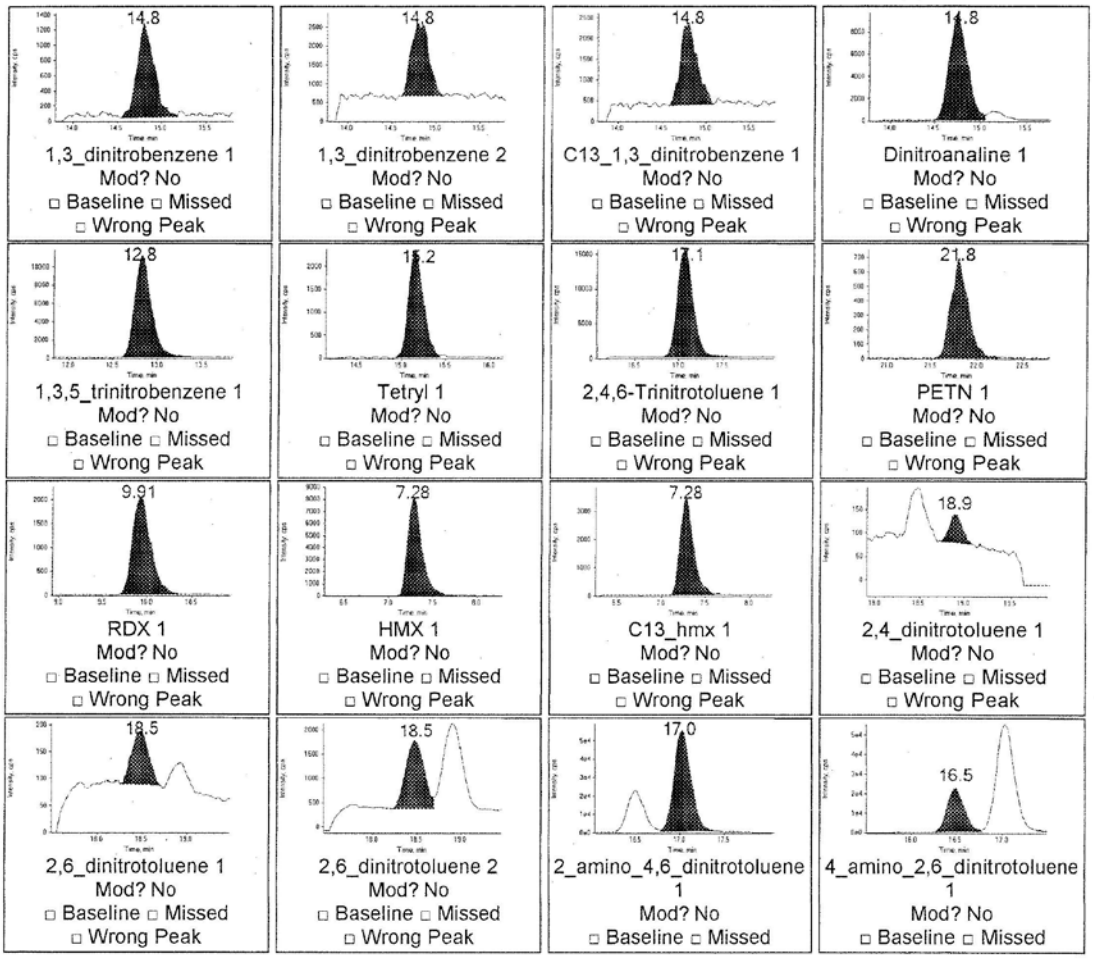
Quantitative Peak Review — Explosives 1ppb



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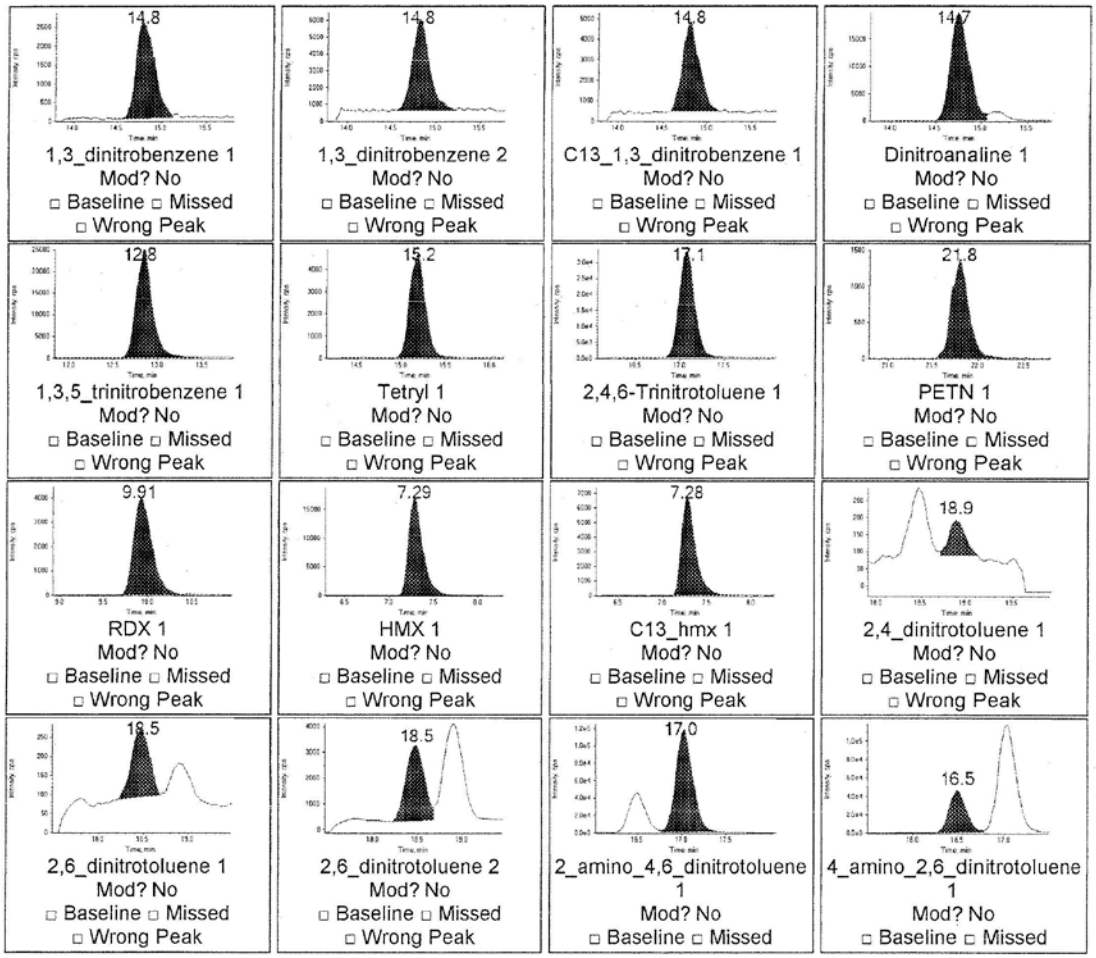
Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 2ppb	**Injection Vial**	3
Acquisition Date	7/30/2012 3:08:21 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23C	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	38099	2.00	2.15	107	No
1,3_dinitrobenzene 2	14.80 (14.80)	73738	2.00	2.22	111	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	58884	2.00	2.11	106	No
Dinitroanaline 1	14.70 (14.80)	280070	2.00	1.99	100	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	318930	2.00	1.92	96	No
Tetryl 1	15.20 (15.20)	57987	2.00	2.00	100	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	418380	2.00	1.97	99	No
PETN 1	21.80 (21.80)	17970	2.00	1.96	98	No
RDX 1	9.91 (9.93)	58166	2.00	1.93	97	No
HMX 1	7.29 (7.28)	192190	2.00	1.94	97	No
C13_hmx 1	7.28 (7.25)	77038	2.00	1.95	97	No
2,4_dinitrotoluene 1	18.90 (18.90)	1317	2.00	2.00	100	No
2,6_dinitrotoluene 1	18.50 (18.50)	2545	2.00	1.71	86	No
2,6_dinitrotoluene 2	18.50 (18.50)	43334	2.00	1.91	96	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	1585600	2.00	1.96	98	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	595980	2.00	1.93	96	No

Quantitative Peak Review — Explosives 2ppb



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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 5ppb	**Injection Vial**	4
Acquisition Date	7/30/2012 3:35:00 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23D	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	**14.80 (14.80)**	**87314**	**5.00**	**5.08**	**102**	No
1,3_dinitrobenzene 2	**14.80 (14.80)**	**169720**	**5.00**	**5.22**	**104**	No
C13_1,3_dinitrobenzene 1	**14.80 (14.80)**	**131410**	**5.00**	**4.83**	**97**	No
Dinitroanaline 1	**14.80 (14.80)**	**717690**	**5.00**	**4.95**	**99**	No
1,3,5_trinitrobenzene 1	**12.80 (12.80)**	**879990**	**5.00**	**5.18**	**104**	No
Tetryl 1	**15.20 (15.20)**	**146800**	**5.00**	**5.19**	**104**	No
2,4,6-Trinitrotoluene 1	**17.10 (17.10)**	**1118500**	**5.00**	**5.42**	**108**	No
PETN 1	**21.80 (21.80)**	**46991**	**5.00**	**5.11**	**102**	No
RDX 1	**9.94 (9.93)**	**150210**	**5.00**	**4.96**	**99**	No
HMX 1	**7.28 (7.28)**	**497870**	**5.00**	**4.78**	**96**	No
C13_hmx 1	**7.28 (7.25)**	**197870**	**5.00**	**4.78**	**96**	No
2,4_dinitrotoluene 1	**18.90 (18.90)**	**3697**	**5.00**	**4.93**	**99**	No
2,6_dinitrotoluene 1	**18.50 (18.50)**	**8302**	**5.00**	**5.46**	**109**	No
2,6_dinitrotoluene 2	**18.50 (18.50)**	**121240**	**5.00**	**5.61**	**112**	No
2_amino_4,6_dinitrotoluene 1	**17.00 (17.00)**	**4253100**	**5.00**	**5.23**	**105**	No
4_amino_2,6_dinitrotoluene 1	**16.50 (16.50)**	**1596700**	**5.00**	**5.18**	**104**	No

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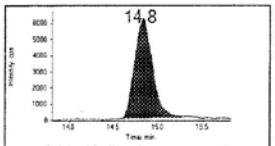
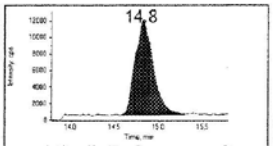
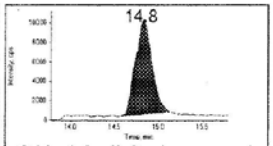
Quantitative Peak Review — Explosives 5ppb



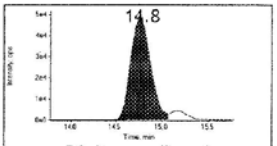
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



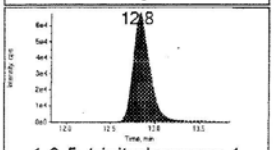
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



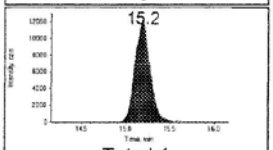
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



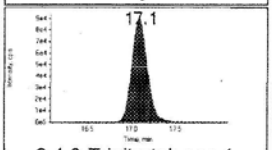
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



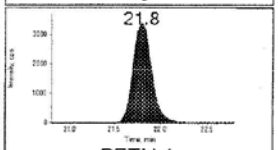
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



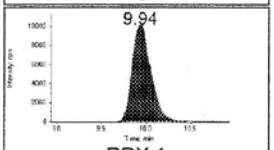
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



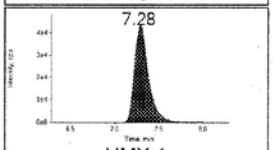
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



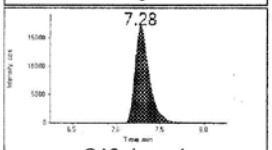
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



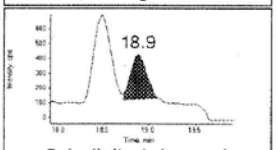
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



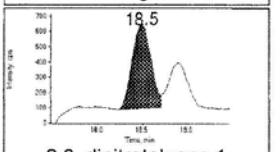
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



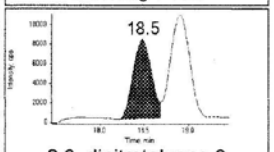
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



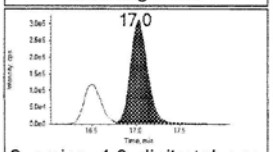
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



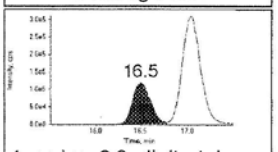
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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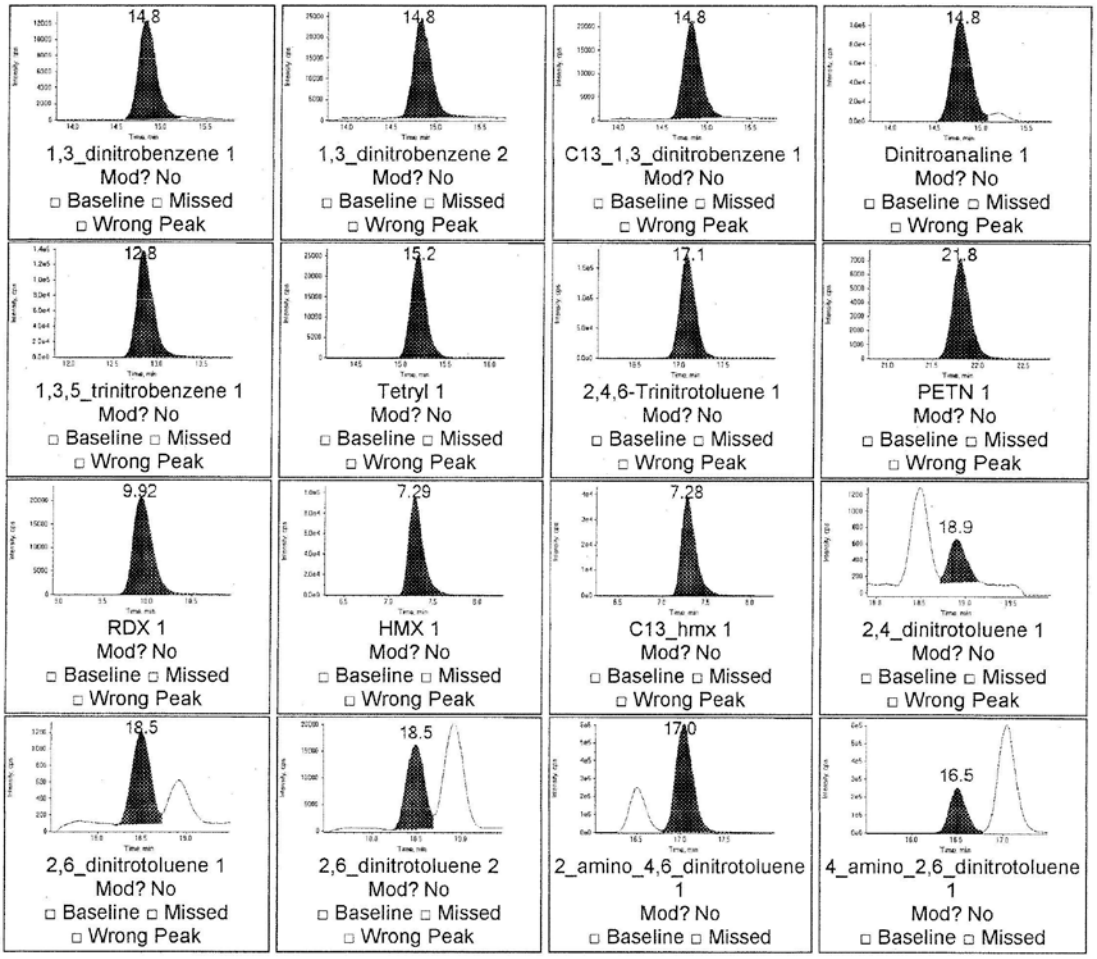
Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 10ppb	**Injection Vial**	5
Acquisition Date	7/30/2012 4:01:40 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23E	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	175080	10.00	10.30	103	No
1,3_dinitrobenzene 2	14.80 (14.80)	343550	10.00	10.60	106	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	285280	10.00	10.60	106	No
Dinitroanaline 1	14.80 (14.80)	1510100	10.00	10.30	103	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	1810000	10.00	10.60	106	No
Tetryl 1	15.20 (15.20)	304640	10.00	10.80	108	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	2147800	10.00	10.50	105	No
PETN 1	21.80 (21.80)	94226	10.00	10.20	102	No
RDX 1	9.92 (9.93)	315590	10.00	10.40	104	No
HMX 1	7.29 (7.28)	1112300	10.00	10.50	105	No
C13_hmx 1	7.28 (7.25)	446710	10.00	10.60	106	No
2,4_dinitrotoluene 1	18.90 (18.90)	7236	10.00	9.29	93	No
2,6_dinitrotoluene 1	18.50 (18.50)	16837	10.00	10.90	109	No
2,6_dinitrotoluene 2	18.50 (18.50)	229400	10.00	10.70	107	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	8428000	10.00	10.40	104	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	3261600	10.00	10.60	106	No

Quantitative Peak Review — Explosives 10ppb



☐ Before ☐ After

8/2/12

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

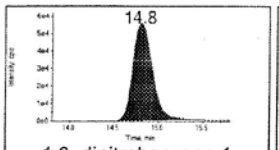
Sample Name	Explosives 50ppb	**Injection Vial**	6
Acquisition Date	7/30/2012 4:28:18 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23F	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

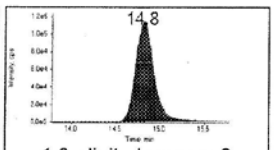
Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	853840	50.00	49.20	99	No
1,3_dinitrobenzene 2	14.80 (14.80)	1664600	50.00	50.50	101	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1404500	50.00	50.60	101	No
Dinitroanaline 1	14.70 (14.80)	7406000	50.00	50.50	101	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	9083800	50.00	53.00	106	No
Tetryl 1	15.20 (15.20)	1367400	50.00	48.10	96	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	10262000	50.00	50.00	100	No
PETN 1	21.80 (21.80)	481820	50.00	50.60	101	No
RDX 1	9.90 (9.93)	1584700	50.00	51.20	102	No
HMX 1	7.27 (7.28)	5391600	50.00	49.70	99	No
C13_hmx 1	7.26 (7.25)	2207200	50.00	50.00	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	40258	50.00	50.00	100	No
2,6_dinitrotoluene 1	18.50 (18.50)	89520	50.00	53.90	108	No
2,6_dinitrotoluene 2	18.50 (18.50)	1222700	50.00	53.70	107	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	38461000	50.00	51.40	103	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	15342000	50.00	51.00	102	No

MM Sholtz 8/2/12

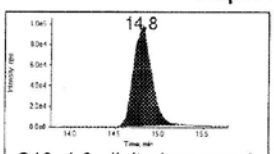
Quantitative Peak Review — Explosives 50ppb



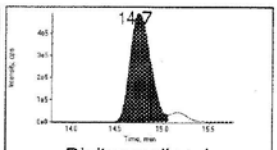
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



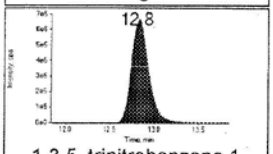
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



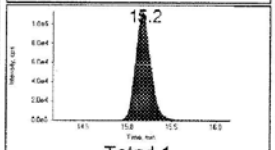
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



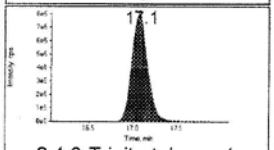
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



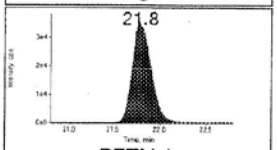
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



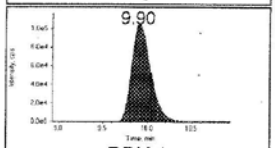
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



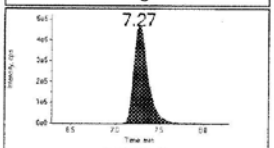
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



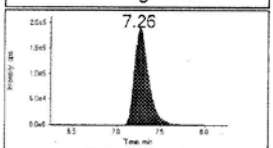
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



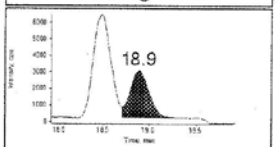
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



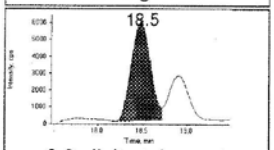
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



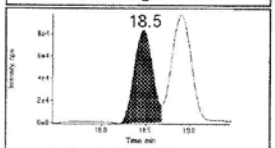
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



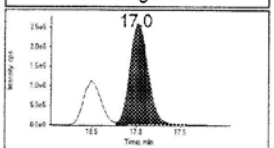
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



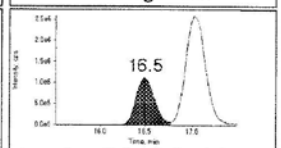
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb	**Injection Vial**	7
Acquisition Date	7/30/2012 4:54:57 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1799000	100.00	100.00	100	No
1,3_dinitrobenzene 2	14.80 (14.80)	3327900	100.00	97.90	98	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2834600	100.00	98.40	98	No
Dinitroanaline 1	14.70 (14.80)	14384000	100.00	98.70	99	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16106000	100.00	94.20	94	No
Tetryl 1	15.20 (15.20)	2946000	100.00	101.00	101	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	20404000	100.00	98.60	99	No
PETN 1	21.80 (21.80)	974460	100.00	98.80	99	No
RDX 1	9.91 (9.93)	3083700	100.00	97.80	98	No
HMX 1	7.27 (7.28)	10999000	100.00	100.00	100	No
C13_hmx 1	7.27 (7.25)	4577300	100.00	99.50	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	75162	100.00	93.00	93	No
2,6_dinitrotoluene 1	18.50 (18.50)	164720	100.00	93.30	93	No
2,6_dinitrotoluene 2	18.50 (18.50)	2254200	100.00	93.50	94	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	65185000	100.00	95.80	96	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	28460000	100.00	97.00	97	No

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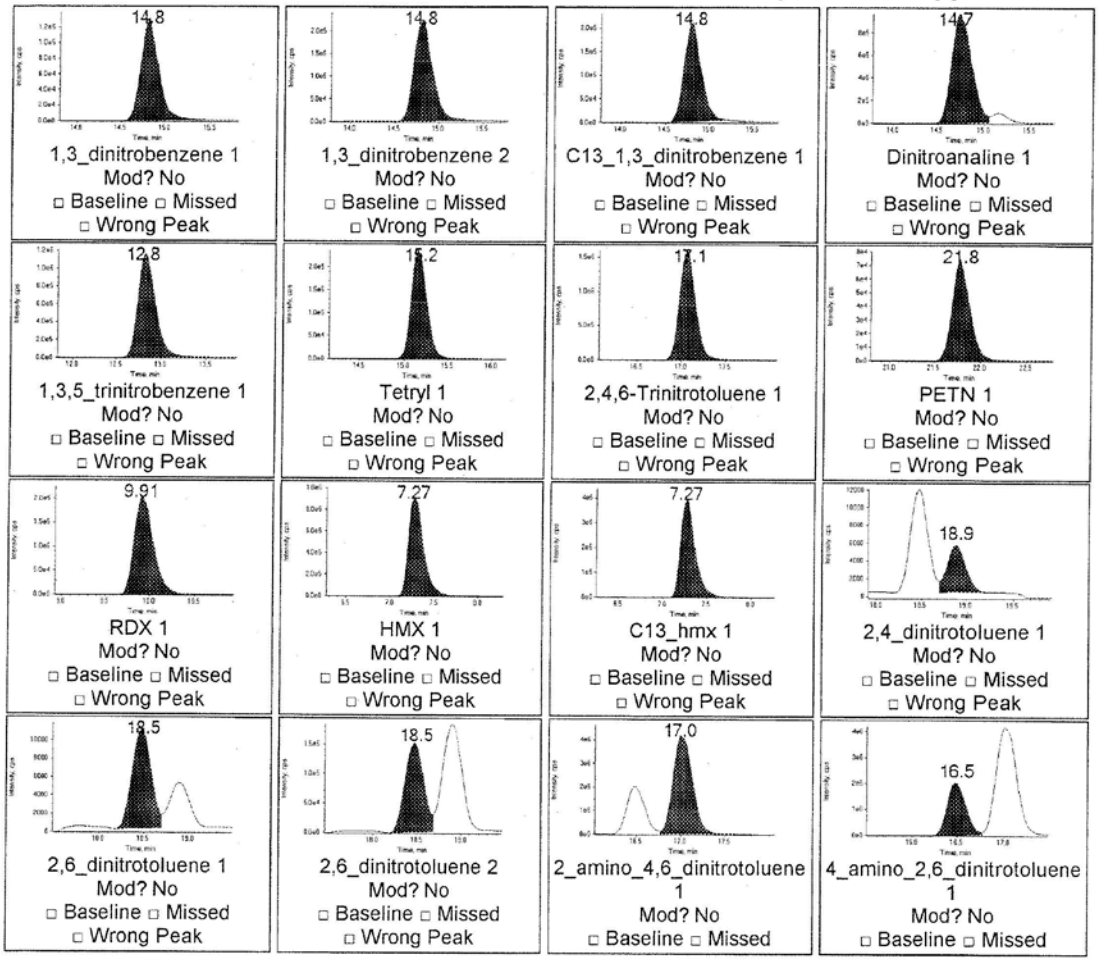
Quantitative Peak Review — Explosives 100ppb



☐ Before ☐ After

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

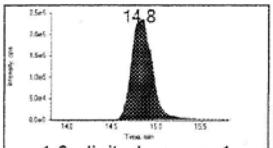
Sample Name	Explosives 200ppb	**Injection Vial**	8
Acquisition Date	7/30/2012 5:21:39 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23H	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

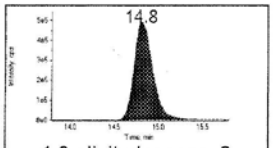
Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	3813400	200.00	200.00	100	No
1,3_dinitrobenzene 2	14.80 (14.80)	7280200	200.00	201.00	100	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	6248600	200.00	201.00	100	No
Dinitroanaline 1	14.80 (14.80)	28844000	200.00	201.00	100	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	34281000	200.00	202.00	101	No
Tetryl 1	15.20 (15.20)	6073100	200.00	200.00	100	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	42338000	200.00	201.00	100	No
PETN 1	21.80 (21.80)	2122000	200.00	200.00	100	No
RDX 1	9.93 (9.93)	6579000	200.00	201.00	100	No
HMX 1	7.28 (7.28)	22548000	200.00	200.00	100	No
C13_hmx 1	7.27 (7.25)	9936700	200.00	200.00	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	168310	200.00	208.00	104	No
2,6_dinitrotoluene 1	18.50 (18.50)	414560	200.00	202.00	101	No
2,6_dinitrotoluene 2	18.50 (18.50)	5623400	200.00	202.00	101	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	105280000	200.00	204.00	102	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	55657000	200.00	201.00	101	No

MHS 8/10/12 8/2/12

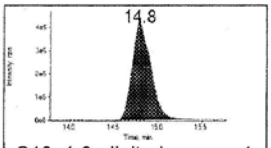
Quantitative Peak Review — Explosives 200ppb



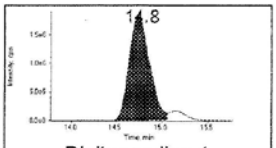
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



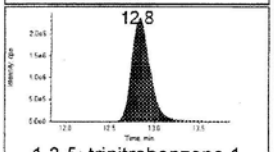
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



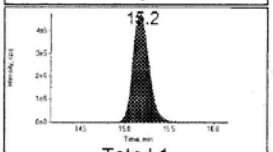
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



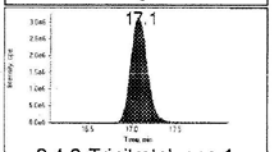
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



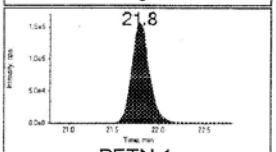
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



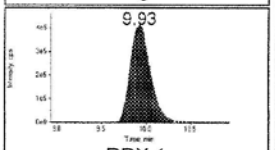
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



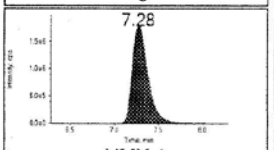
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



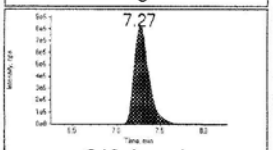
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



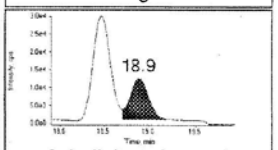
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



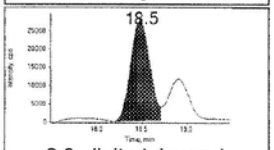
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



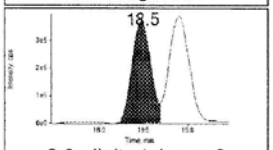
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



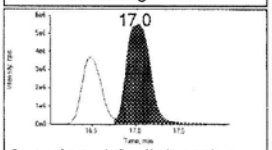
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



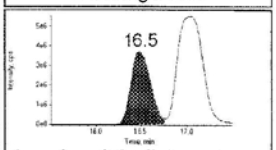
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	113	NA	NA	NA	12.8	± 30 %	Quadratic
RDX	100	110	NA	NA	NA	9.5	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	114	NA	NA	NA	14.0	± 30 %	Quadratic
1,3-Dinitrobenzene	100	125	NA	NA	NA	25.2	± 30 %	Quadratic
Tetryl	100	122	NA	NA	NA	21.6	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	123	NA	NA	NA	22.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	115	NA	NA	NA	14.7	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	118	NA	NA	NA	18.2	± 30 %	Quadratic
2,4-Dinitrotoluene	100	112	NA	NA	NA	12.4	± 30 %	Linear
2,6-Dinitrotoluene	100	117	NA	NA	NA	17.3	± 30 %	Quadratic
3,5-Dinitroaniline	100	112	NA	NA	NA	12.2	± 30 %	Quadratic
C13-HMX	100	106	NA	NA	NA	5.8	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	117	NA	NA	NA	16.7	± 30 %	Quadratic
PETN	100	111	NA	NA	NA	11.4	± 30 %	Quadratic

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

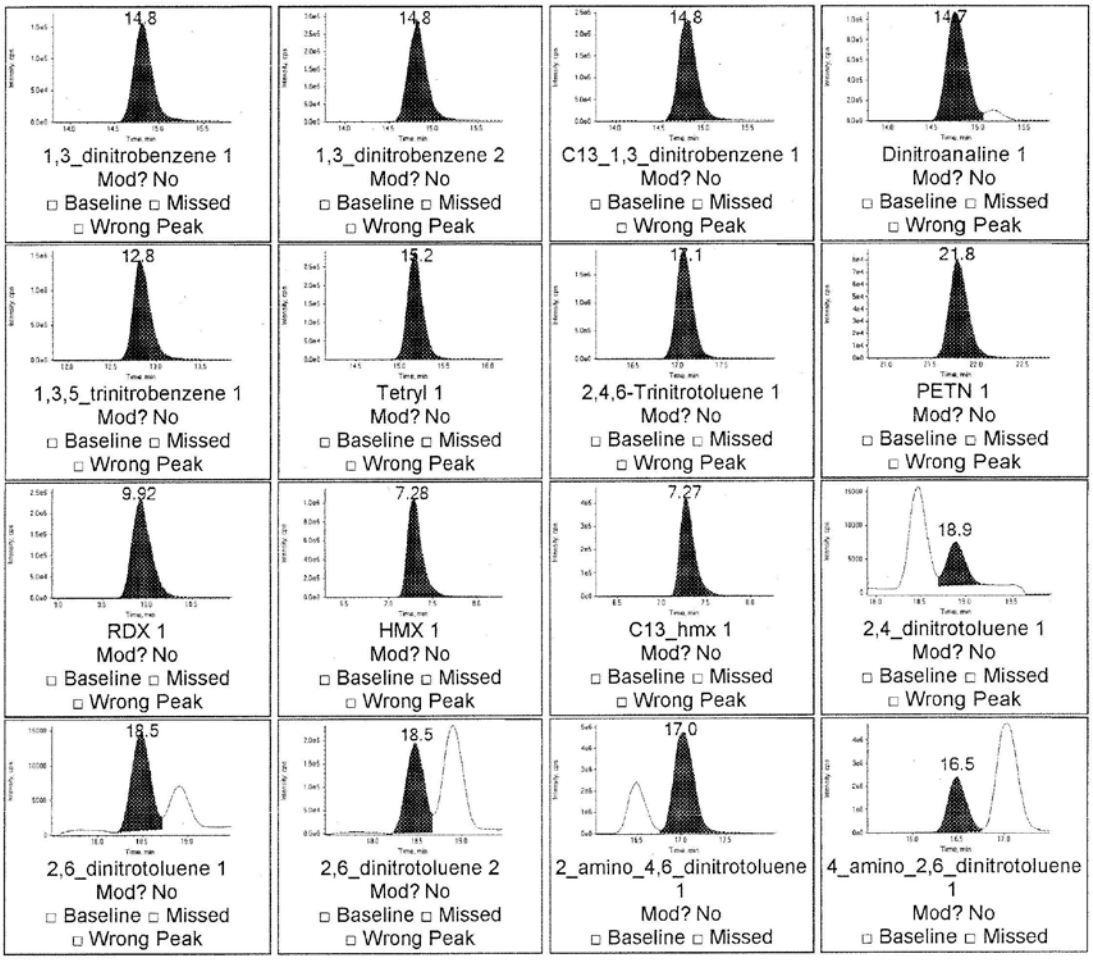
Sample Name	Explosives 100ppb ICV	**Injection Vial**	9
Acquisition Date	7/30/2012 6:41:40 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23K	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	2278900	100.00	125.00	125	No
1,3_dinitrobenzene 2	14.80 (14.80)	4163600	100.00	121.00	121	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	3409900	100.00	117.00	117	No
Dinitroanaline 1	14.70 (14.80)	16330000	100.00	112.00	112	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	19454000	100.00	114.00	114	No
Tetryl 1	15.20 (15.20)	3573300	100.00	122.00	122	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	25539000	100.00	123.00	123	No
PETN 1	21.80 (21.80)	1109400	100.00	111.00	111	No
RDX 1	9.92 (9.93)	3468900	100.00	110.00	110	No
HMX 1	7.28 (7.28)	12443000	100.00	113.00	113	No
C13_hmx 1	7.27 (7.25)	4889600	100.00	106.00	106	No
2,4_dinitrotoluene 1	18.90 (18.90)	90915	100.00	112.00	112	No
2,6_dinitrotoluene 1	18.50 (18.50)	214560	100.00	117.00	117	No
2,6_dinitrotoluene 2	18.50 (18.50)	2855600	100.00	115.00	115	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	76451000	100.00	118.00	118	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	33311000	100.00	115.00	115	No

8/2/12

Quantitative Peak Review — Explosives 100ppb ICV



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206334
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	95.3	NA	NA	NA	-4.7	± 30 %	Quadratic
RDX	100	86.6	NA	NA	NA	-13.4	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	99.1	NA	NA	NA	-0.9	± 30 %	Quadratic
1,3-Dinitrobenzene	100	106	NA	NA	NA	6.2	± 30 %	Quadratic
Tetryl	100	96.9	NA	NA	NA	-3.1	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	104	NA	NA	NA	3.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	99.5	NA	NA	NA	-0.5	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	100	NA	NA	NA	0.0	± 30 %	Quadratic
2,4-Dinitrotoluene	100	83.1	NA	NA	NA	-16.9	± 30 %	Linear
2,6-Dinitrotoluene	100	115	NA	NA	NA	15.0	± 30 %	Quadratic
3,5-Dinitroaniline	100	99.0	NA	NA	NA	-1.0	± 30 %	Quadratic
C13-HMX	100	91.7	NA	NA	NA	-8.3	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	103	NA	NA	NA	3.0	± 30 %	Quadratic
PETN	100	95.9	NA	NA	NA	-4.1	± 30 %	Quadratic

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/30/2012 11:34:55 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

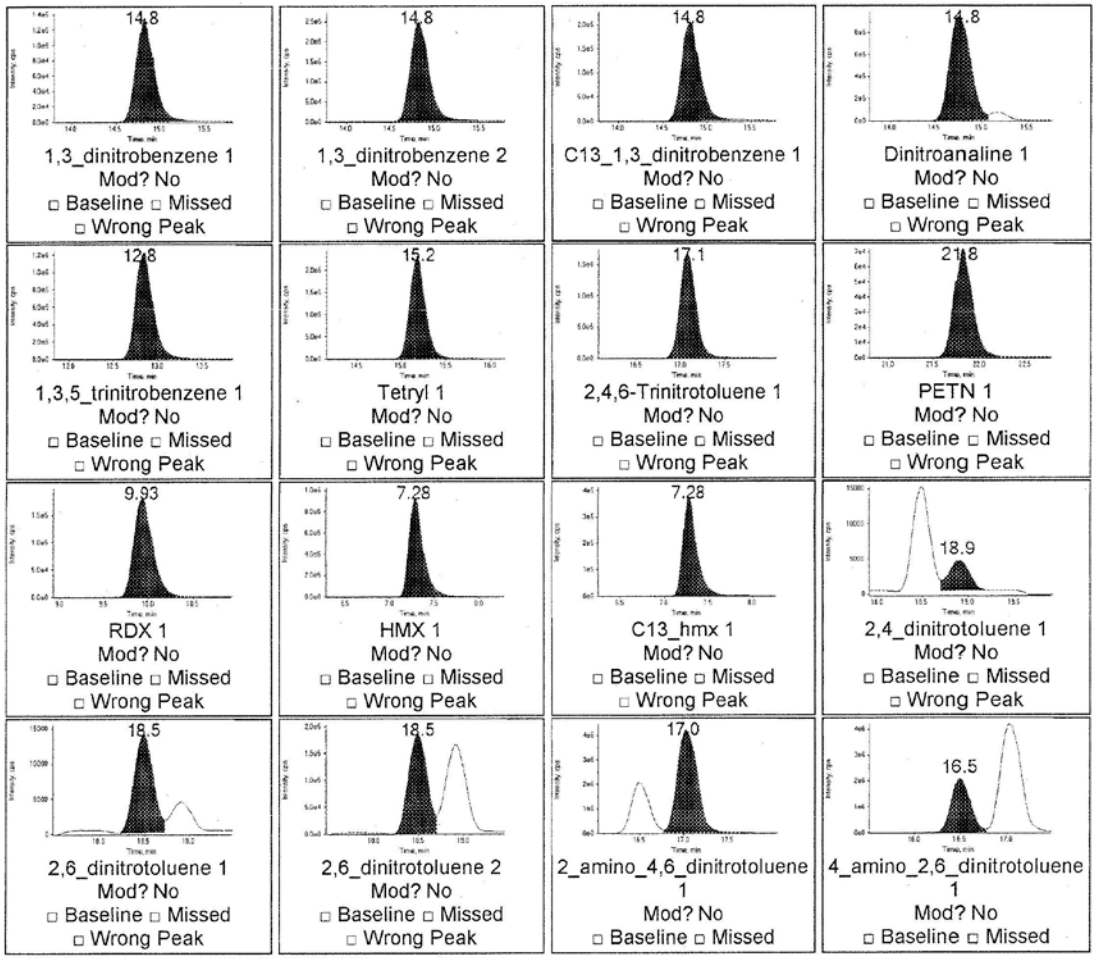
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1910500	100.00	106.00	106	No
1,3_dinitrobenzene 2	14.80 (14.80)	3652300	100.00	107.00	107	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2979100	100.00	103.00	103	No
Dinitroanaline 1	14.80 (14.80)	14426000	100.00	99.00	99	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16932000	100.00	99.10	99	No
Tetryl 1	15.20 (15.20)	2815000	100.00	96.90	97	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	21508000	100.00	104.00	104	No
PETN 1	21.80 (21.80)	944280	100.00	95.90	96	No
RDX 1	9.93 (9.93)	2718400	100.00	86.60	87	No
HMX 1	7.28 (7.28)	10471000	100.00	95.30	95	No
C13_hmx 1	7.28 (7.25)	4191400	100.00	91.70	92	No
2,4_dinitrotoluene 1	18.90 (18.90)	67173	100.00	83.10	83	No
2,6_dinitrotoluene 1	18.50 (18.50)	209540	100.00	115.00	115	No
2,6_dinitrotoluene 2	18.50 (18.50)	2738700	100.00	111.00	111	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	67422000	100.00	100.00	100	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	29137000	100.00	99.50	100	No

8/2/12

8/2/12

Quantitative Peak Review — Explosives 100ppb CCV



☐ Before ☐ After

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/31/2012 4:28:05 AM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

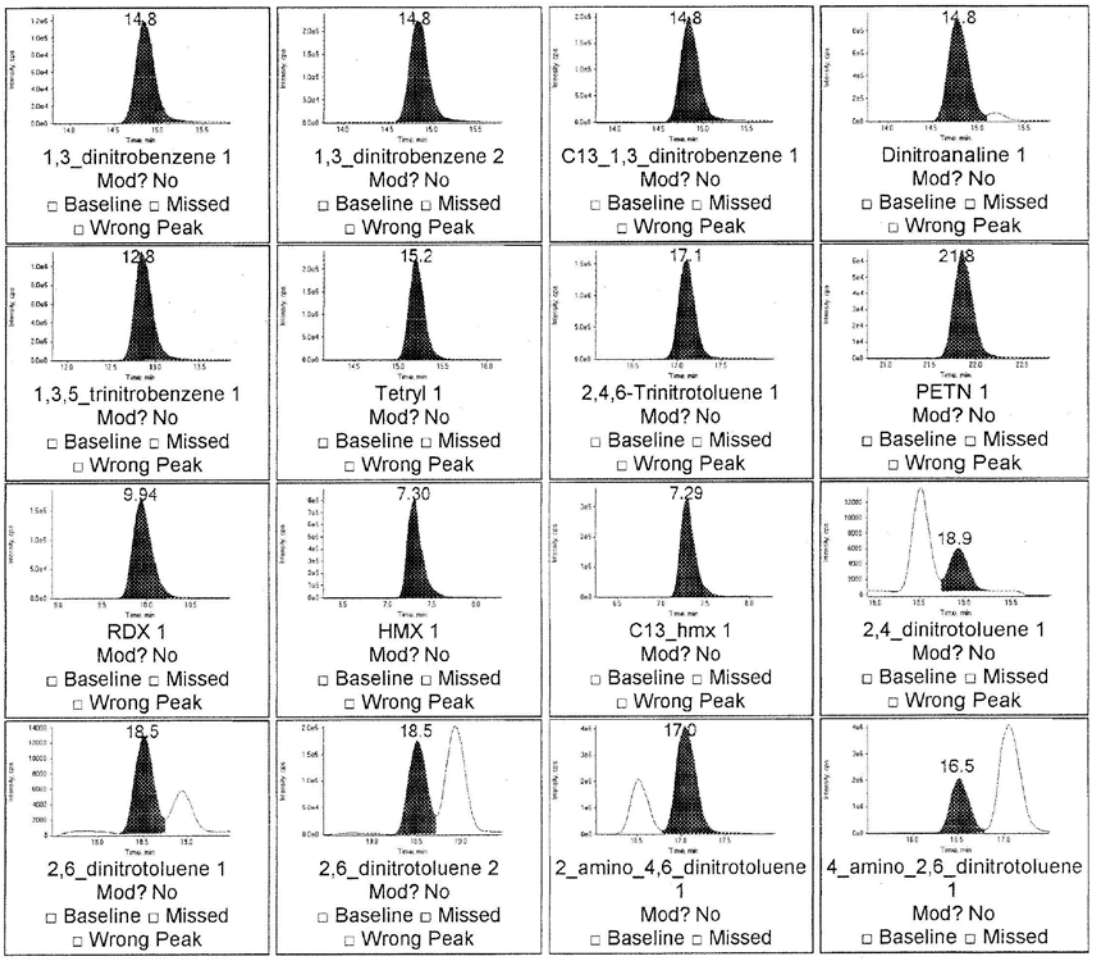
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1809300	100.00	101.00	101	No
1,3_dinitrobenzene 2	14.80 (14.80)	3464600	100.00	102.00	102	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2904300	100.00	101.00	101	No
Dinitroanaline 1	14.80 (14.80)	13737000	100.00	94.20	94	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16134000	100.00	94.40	94	No
Tetryl 1	15.20 (15.20)	2747600	100.00	94.60	95	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	20734000	100.00	100.00	100	No
PETN 1	21.80 (21.80)	917040	100.00	93.30	93	No
RDX 1	9.94 (9.93)	2530100	100.00	80.80	81	No
HMX 1	7.30 (7.28)	9337400	100.00	85.20	85	No
C13_hmx 1	7.29 (7.25)	3829800	100.00	84.30	84	No
2,4_dinitrotoluene 1	18.90 (18.90)	83967	100.00	104.00	104	No
2,6_dinitrotoluene 1	18.50 (18.50)	190140	100.00	106.00	106	No
2,6_dinitrotoluene 2	18.50 (18.50)	2575600	100.00	105.00	105	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	65096000	100.00	95.60	96	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	28963000	100.00	98.80	99	No

* 8/2/12

8/10/12

Quantitative Peak Review — Explosives 100ppb CCV



☐ Before ☐ After

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/31/2012 9:21:25 AM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

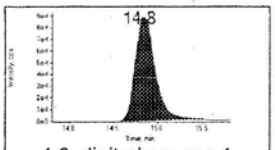
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1378600	100.00	78.10	78	No
1,3_dinitrobenzene 2	14.80 (14.80)	2681900	100.00	79.80	80	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2171900	100.00	76.70	77	No
Dinitroanaline 1	14.80 (14.80)	11327000	100.00	77.50	78	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	15055000	100.00	88.10	88	No
Tetryl 1	15.20 (15.20)	2345200	100.00	81.20	81	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	15733000	100.00	76.30	76	No
PETN 1	21.80 (21.80)	940520	100.00	95.50	96	No
RDX 1	9.93 (9.93)	2485700	100.00	79.40	79	No
HMX 1	7.28 (7.28)	9570200	100.00	87.30	87	No
C13_hmx 1	7.28 (7.25)	3931800	100.00	86.40	86	No
2,4_dinitrotoluene 1	18.90 (18.90)	54682	100.00	67.70	68	No
2,6_dinitrotoluene 1	18.50 (18.50)	123290	100.00	72.10	72	No
2,6_dinitrotoluene 2	18.50 (18.50)	1617800	100.00	69.50	70	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	53738000	100.00	75.50	76	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	25378000	100.00	86.00	86	No

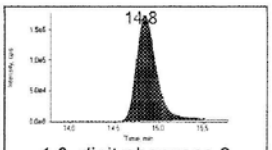
8/2/12

8/10/12

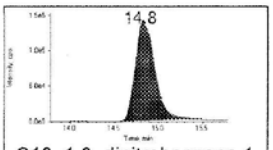
Quantitative Peak Review — Explosives 100ppb CCV



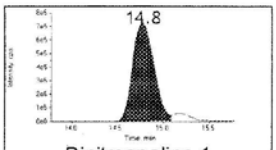
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



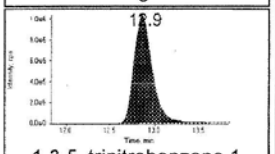
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



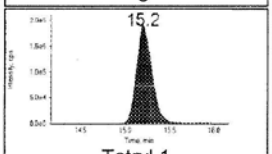
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



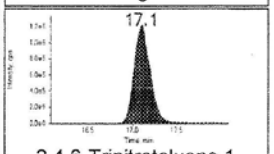
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



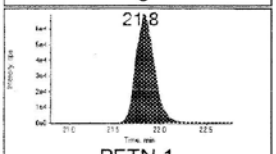
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



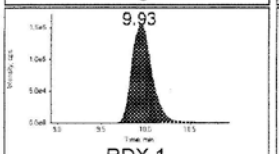
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



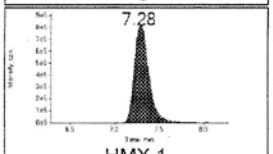
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



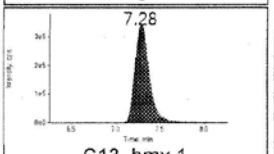
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



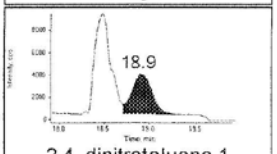
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



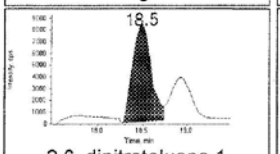
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



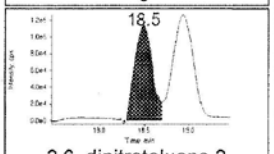
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



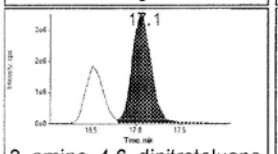
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



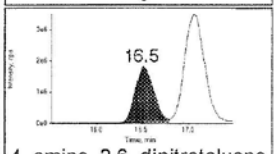
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Sample Prep and Screen Data

Preparation Information Benchsheet

Prep Run#: 161950
Team: Organic LC/SJONES
Number of Copies to make: 1

Prep WorkFlow: OrgExtS(14)
Prep Method: CAS SOP

Status: Final Volume
Prep Date/Time: 7/6/12 09:28 AM

#	Lab Code	Client ID	B#	Method /Test	pH	Matrix	Amt. Ext.	Final Vol	Sample Description
1	K1206334-001	PS-OD-SVOC-061312	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.1580g	100.00mL	
2	K1206334-002	PS-OD-SVOC-061412	.01	CAS SOP/Nitroaromatics	N/A	Filter	7.7080g	100.00mL	
3	K1206334-003	PS-OD-SVOC-061512	.01	CAS SOP/Nitroaromatics	N/A	Filter	6.6220g	100.00mL	
4	K1206334-004	PS-OD-SVOC-061612-01	.01	CAS SOP/Nitroaromatics	N/A	Filter	9.7990g	100.00mL	
5	K1206334-005	PS-OD-SVOC-061612-02	.01	CAS SOP/Nitroaromatics	N/A	Filter	8.8150g	100.00mL	
6	K1206334-006	PS-OD-SVOC-061612-03	.01	CAS SOP/Nitroaromatics	N/A	Filter	6.9440g	100.00mL	
7	K1206334-007	PS-OD-SVOC-061812-01	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.6970g	100.00mL	
8	K1206334-008	PS-OD-SVOC-061812-02	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.1210g	100.00mL	
9	K1206334-009	PS-OD-SVOC-061912	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.5790g	100.00mL	
10	K1206334-010	PS-OD-SVOC-062012	.01	CAS SOP/Nitroaromatics	N/A	Filter	4.6590g	100.00mL	
11	K1206334-011	PS-OD-SVOC-062112-01	.01	CAS SOP/Nitroaromatics	N/A	Filter	4.9580g	100.00mL	
12	K1206334-012	PS-OD-SVOC-062112-02	.01	CAS SOP/Nitroaromatics	N/A	Filter	7.4110g	100.00mL	
13	K1206334-013	PS-OD-SVOC-062212	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.7940g	100.00mL	
14	K1206334-014	PS-OD-SVOC-062512-01	.01	CAS SOP/Nitroaromatics	N/A	Filter	6.3350g	100.00mL	
15	K1206334-015	PS-OD-SVOC-062512-02	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.7100g	100.00mL	
16	K1206334-016	PS-OD-SVOC-062612	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.9440g	100.00mL	
17	K1206334-017	PS-OD-SVOC-062812	.01	CAS SOP/Nitroaromatics	N/A	Filter	5.0250g	100.00mL	
18	KQ1207704-01	LCS	—	CAS SOP/Nitroaromatics	N/A	Solid	10.0000g	100.00mL	
19	KQ1207704-02	DLCS	—	CAS SOP/Nitroaromatics	N/A	Solid	10.0000g	100.00mL	
20	KQ1207704-03	MB	—	CAS SOP/Nitroaromatics	N/A	Solid	10.0000g	100.00mL	

165

K-165

Preparation Steps

Step: Extraction
Started: 7/6/12 09:28
Finished: 7/10/12 19:02
By: SJONES
Comments:

Comments:

Preparation Information Benchsheet

Prep Run#: 161950
Team: Organic LC/SJONES

Prep WorkFlow: OrgExtS(14)
Prep Method: CAS SOP

Status: Final Volume
Prep Date/Time: 7/6/12 09:28 AM

166

K-166

Reviewed By: [illegible] Date: 8/2/12 Spike Witness: MHALL Date: —

Chain of Custody

Relinquished By:	S. Jones	Date:	7.10.12	Extracts Examined: Yes / No
Received By:	[illegible]	Date:	8/2/12	

Preparation Information Benchsheet

rep Run#: 161950
'eam: Organic LC/SJONES
Number of Copies to make: 1

Prep WorkFlow: OrgExtS(14)
Prep Method: CAS SOP

Status: Draft
Prep Date/Time: 7/6/12 09:28 AM

#	Lab Code	Client ID	B#	√	Method /Test	Matrix	Amt. Ext. (g)	pH	Int. Vol	Final Vol	Surr Amt	Spike Amt
1	K1206334-001	PS-OD-SVOC-061312	.01		CAS SOP / Nitroaromatics	Filter	5.158	N/A	N/A	100ml	500ul	N/A
2	K1206334-002	PS-OD-SVOC-061412	.01		CAS SOP / Nitroaromatics	Filter	7.708					
3	K1206334-003	PS-OD-SVOC-061512	.01		CAS SOP / Nitroaromatics	Filter	6.622					
4	K1206334-004	PS-OD-SVOC-061612-01	.01		CAS SOP / Nitroaromatics	Filter	9.799					
5	K1206334-005	PS-OD-SVOC-061612-02	.01		CAS SOP / Nitroaromatics	Filter	8.815					
6	K1206334-006	PS-OD-SVOC-061612-03	.01		CAS SOP / Nitroaromatics	Filter	10.944					
7	K1206334-007	PS-OD-SVOC-061812-01	.01		CAS SOP / Nitroaromatics	Filter	5.697					
8	K1206334-008	PS-OD-SVOC-061812-02	.01		CAS SOP / Nitroaromatics	Filter	5.121					
9	K1206334-009	PS-OD-SVOC-061912	.01		CAS SOP / Nitroaromatics	Filter	5.579					
10	K1206334-010	PS-OD-SVOC-062012	.01		CAS SOP / Nitroaromatics	Filter	4.639					
11	K1206334-011	PS-OD-SVOC-062112-01	.01		CAS SOP / Nitroaromatics	Filter	4.958					
12	K1206334-012	PS-OD-SVOC-062112-02	.01		CAS SOP / Nitroaromatics	Filter	7.411					
13	K1206334-013	PS-OD-SVOC-062212	.01		CAS SOP / Nitroaromatics	Filter	5.794					
14	K1206334-014	PS-OD-SVOC-062512-01	.01		CAS SOP / Nitroaromatics	Filter	6.335					
15	K1206334-015	PS-OD-SVOC-062512-02	.01		CAS SOP / Nitroaromatics	Filter	5.710					
16	K1206334-016	PS-OD-SVOC-062612	.01		CAS SOP / Nitroaromatics	Filter	5.944					
17	K1206334-017	PS-OD-SVOC-062812	.01		CAS SOP / Nitroaromatics	Filter	5.025					
18	KQ1207704-01	LCS			CAS SOP / Nitroaromatics	Solid	10.000					500ml
19	KQ1207704-02	DLCS			CAS SOP / Nitroaromatics	Solid	10.000					
20	KQ1207704-03	MB			CAS SOP / Nitroaromatics	Solid	10.000					N/A

Comments: Insufficient Samyple quantity for Q.C. Because of the matrix; 100ml of Solvent was used and 5x the normal Spike + Surrogate were used

Surrogate ID: 12-OLC-01-16F@10ppm, exp. 6-25-13, 500ml (PHCE-11)

Spike ID: 12-OLC-01-20Q @10ppm, exp. 10-25-12, ~~100ml~~ 500 (PHCE-11) 7/13/12

Witnessed By: 7/9/12

Analyst: S.Jones

Assisted By: —

Additional Prep Information For Nitroaromatics by LC/MS/MS – SOP: LCP-LCMS4 (rev. 1)

Service Request # K1206334 **Work Group #** K1207704

Solvents/Reagents used:

0.1% Glacial Acetic Acid/ACN Lot# PHCRE-101-31M

5mM Ammonium Acetate/Water Lot# PHCRE-101-19S

ACN Lot# 52101 **Reagent Water Lot#** 52074

Sonic Bath Start (Time/Date/Initial): 17:00 / 7-09-12 / SJ

Sonic Bath Stop (Time/Date/Initial): 11:05 / 7-10-12 / SJ

3cc Oasis HLB cartridge Lot# 099A30188A

Extraction Start (Time/Date/Initial): 14:00 / 7-10-12 / SJ

Extraction Stop (Time/Date/Initial): 16:00 / 7-10-12 / SJ

Final Volume Start (Time/Date/Initial): 17:10 / 7-10-12 / SJ

Final Volume Stop (Time/Date/Initial): 18:45 / 7-10-12 / SJ

Completion (Time/Date/Initial) 18:45 / 7-10-12 / SJ **Vial Storage:** Top Shelf

Archived Extract Storage: Bottom

Comments/Observations:

Bench Sheet Review Check List
☑ Hold Times Met (if no, Reason:)
☑ Prep date, dept, method, product code correct in stealth
☑ Spike Information correct
☑ Weights/Volumes and units correct on raw and final bench sheets
☑ Sample IDs have been checked—Bottle numbers appended if required
☑ Names present for: Started by, Completed by, relinquished by, and witnessed by.
☑ Training has been circled
☑ Extract Storage recorded
☑ Additional Prep Sheet completely filled out (NA or line out Blanks)
☑ All clean-ups have been noted on additional prep sheet
☑ Signed service request with Form V, if applicable, has been attached

R:\OLC\benchsheets\Additional Prep Information nitroaromatics soil.doc

Appendix L: Laboratory Report for Energetics in Soil

August 15, 2012

Analytical Report for Service Request No: K1206333
Revised Service Request No: K1206333.01

Dennis Tabor
US Environmental Protection Agency (E-305-01)
Office of Research & Development National Risk Man
109 T.W. Alexander Drive
Research Traingel Park, NC 27711

RE: Explosive Residue

Dear Dennis:

Enclosed are the revised pages for the samples submitted to our laboratory on June 30, 2012. For your reference, these analyses have been assigned our service request number K1206333.

The client requested the data be reported to the MDL.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.caslab.com. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please call if you have any questions. My extension is 3291. You may also contact me via Email at Ed.Wallace@alsglobal.com.

Respectfully submitted,

Columbia Analytical Services, Inc.

Ed Wallace
Project Manager

REVISED
6:21 pm, Aug 16, 2012

EW/as

Page 1 of 129

Columbia Analytical Services
ADDRESS 1317 S. 13th Avenue, Kelso, WA 98626
PHONE +1 360 577 7222 | FAX +1 360 636 1068
Columbia Analytical Services, Inc.
Part of the ALS Group A Campbell Brothers Limited Company
Environmental www.caslab.com ▪ www.alsglobal.com
RIGHT SOLUTIONS RIGHT PARTNER

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
E	The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
M	The duplicate injection precision was not met.
N	The Matrix Spike sample recovery is not within control limits. See case narrative.
S	The reported value was determined by the Method of Standard Additions (MSA).
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
W	The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

*	The result is an outlier. See case narrative.
#	The control limit criteria is not applicable. See case narrative.
A	A tentatively identified compound, a suspected aldol-condensation product.
B	The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
E	The result is an estimated value.
J	The result is an estimated value.
N	The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
P	The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

F	The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
H	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
Y	The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
Z	The chromatographic fingerprint does not resemble a petroleum product.

Columbia Analytical Services, Inc. - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Louisiana DHH	Not available	LA110003
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
New Mexico ED	http://www.nmenv.state.nm.us/dwb/Index.htm	-
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	4704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.caslab.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.caslab.com or at the accreditation bodies web site

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

Case Narrative

ALS ENVIRONMENTAL

Client:	US Environmental Protection Agency	**Service Request No.:**	K1206333
Project:	Explosive Residue Tooele Depot	**Date Received:**	6/30/12
Sample Matrix:	Soil		

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier IV validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Five soil samples were received for analysis at ALS Environmental on 6/30/12. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4°C upon receipt at the laboratory.

Explosives by EPA Method 8330

Surrogate Exceptions:
The recovery of surrogate C13-HMX in some samples was outside the control limits listed in the results summary. The limits are default values temporarily in use until sufficient data points are generated to calculate statistical control limits. Based on the method and historic data, the recoveries observed were in the range expected for this procedure. No further corrective action was taken.

Matrix Spike Recovery Exceptions:
The recovery of some analytes in the matrix spike samples were outside the control limits listed in the results summary. The limits are default values temporarily in use until sufficient data points are generated to calculate statistical control limits. Based on the method and historic data, the recoveries observed were in the range expected for this procedure. No further corrective action was taken.

Relative Percent Difference Exceptions:
The Relative Percent Difference (RPD) for Tetryl and 2,6-Dinitrotoluene in the replicate Matrix Spikes was outside control criteria. No further corrective action was taken as the hold time had expired by the time the problem was noted. The data was flagged to indicate the problem.

Lab Control Sample Exceptions:
The recovery of some analytes in the Lab Control samples were outside the control limits listed in the results summary. The limits are default values temporarily in use until sufficient data points are generated to calculate statistical control limits. Based on the method and historic data, the recoveries observed were in the range expected for this procedure. No further corrective action was taken.

Approved by EMW **Date** 8/13/12

Chain of Custody

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Lab Work Order # K120 4333

Page of 1

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX			1	2	3	4	5	6	7	8	9	10	Remarks
BS-Soil-061120	6/11/12	soil	255291			X	X	X								predetonation soil
PD-Comp-B-6182	6/18/12	soil	478495			X	X	X								post detonation comp B soil
BS-Sand fill	6/19/12	soil	478496			X	X	X								sand used as fill
PD-V453	6/22/12	soil	478492			X	X	X								post detonation V453
PD-Final	6/28/12	soil	255290			X	X	X								post detonation Final

Requested Analyses

1 RDX
2 HMX
3 TNT
4
5
6
7

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:
Shipping Tracking #
Specify Turnaround Requirements:

☒ Cooler packed with ice
☐ Cooler custody seal intact

Sample Receipt:
Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
Robert Blank	6/29/12	0945					
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
	6/30/12	9:20	[illegible]				

PC 1

Cooler Receipt and Preservation Form

Client / Project: Tooele Army Depot Service Request K12 0 6333

Received: 6/30/12 Opened: 6/30/12 By: BT Unloaded: 6/30/12 By: BT

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *PDX* *Courier* *Hand Delivered*
2. Samples were received in: (circle) *Cooler* *Box* *Envelope* *Other* _____ *NA*
3. Were custody seals on coolers? NA Y N If yes, how many and where? _____

   If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Cooler Temp °C	Temp Blank °C	Thermometer ID	Cooler/COC ID NA	Tracking Number	NA	Filed
1.8	2.4	289		1Z A5E76244 9575 0206		

7. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____
8. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA Y N
10. Were all sample labels complete (i.e analysis, preservation, etc.)? NA Y N
11. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA Y N
12. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
13. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA Y N
14. Were VOA vials received without headspace? *Indicate in the table below.* NA Y N
15. Was C12/Res negative? NA Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time

Notes, Discrepancies, & Resolutions: _____

Total Solids

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group

Analytical Results

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil

Service Request: K1206333

Total Solids

Prep Method: NONE
Analysis Method: 160.3M
Test Notes:

Units: PERCENT
Basis: Air Dried

Sample Name	Lab Code	Date Collected	Date Received	Date Analyzed	Result	Result Notes
BS-Soil-061112-01	K1206333-001	06/11/2012	06/30/2012	07/09/2012	99.5	
PD-Comp-B-6-18-2	K1206333-002	06/18/2012	06/30/2012	07/09/2012	99.5	
BS-Sand Fill	K1206333-003	06/19/2012	06/30/2012	07/09/2012	99.6	
PD-V453	K1206333-004	06/22/2012	06/30/2012	07/09/2012	99.6	
PD-Final	K1206333-005	06/28/2012	06/30/2012	07/09/2012	99.5	

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	06/28/2012
Sample Matrix:	Soil	**Date Received:**	06/30/2012
		Date Analyzed:	07/09/2012

Duplicate Sample Summary
Total Solids

Prep Method:	NONE	**Units:**	PERCENT
Analysis Method:	160.3M	**Basis:**	Air Dried
Test Notes:			

Sample Name	Lab Code	Sample Result	Duplicate Sample Result	Average	Relative Percent Difference	Result Notes
PD-Final	K1206333-005	99.5	99.5	99.5	<1	

COLUMBIA ANALYTICAL SERVICES, INC.

EPA Method 160.3 - Total Solids

Group ID:	KWG1207615				
Analyst:	PFaiman/RA	Run # 299416		**Reviewed By:**	
Date Acquired:	07/09/2012 00:00	**Oven TempStart:**	105 DEG C	**Date Reviewed:**	7/10/12
Date Completed:	07/10/2012 00:00	**Oven TempEnd:**	105 DEG C		

#	Lab Code	Client ID	Matrix	Tare	Tare+Wet	Tare+Dry	% Solids	QC Ref Sample	Comments
1	K1206306-001	CSMIS-1	SOIL	1.30g	16.51g	16.01g	96.7		K-BALANCE-16
2	K1206306-002	CSMIS-2	SOIL	1.29g	16.35g	16.04g	97.9		K-BALANCE-16
3	K1206306-003	CSMIS-3	SOIL	1.30g	16.38g	16.04g	97.7		K-BALANCE-16
4	K1206333-001	BS-Soil-061112-01	SOIL	1.29g	11.39g	11.34g	99.5		K-BALANCE-16
5	K1206333-002	PD-Comp-B-6-18-2	SOIL	1.29g	11.39g	11.34g	99.5		K-BALANCE-16
6	K1206333-003	BS-Sand Fill	SOIL	1.30g	11.38g	11.34g	99.6		K-BALANCE-16
7	K1206333-004	PD-V453	SOIL	1.30g	11.38g	11.34g	99.6		K-BALANCE-16
8	K1206333-005	PD-Final	SOIL	1.30g	11.39g	11.34g	99.5		K-BALANCE-16
9	KWG1207615-1	Duplicate Client Sample	SOIL	1.30g	11.38g	11.33g	99.5	K1206333-005	K-BALANCE-16 $\bar{x}$= 99.5 RPD= 0
10	KWG1207615-2	Duplicate Client Sample	SOIL	1.31g	16.38g	16.03g	97.7	K1206306-003	K-BALANCE-16 $\bar{x}$= 97.7 RPD 0

Service Request #: K1206333

Analysis: Multi Incrimental Sampling (MIS/ISM)

Sample Number	+2mm Fraction Air Dried Weight (g)	Comments, Description of +2mm Fraction	-2mm Fraction Air Dried Weight (g)	-2mm Fraction Multi Incrimental Sample Aliquots									
				Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)	Test	Sample Wt. (g)
K1206333-001	51.63	Rocks 2mm-2cm	306.86	Nitro	10.06	TS	10.09	—	—	—	—	—	—
K1206333-002	47.04	Rocks 2mm-1.5cm	260.11	Nitro	10.05	TS	10.09	—	—	—	—	—	—
K1206333-003	12.20	Rocks 2-8mm	287.68	Nitro	10.05	TS	10.09	—	—	—	—	—	—
K1206333-004	24.35	Rocks 2-8mm	308.25	Nitro	10.04	TS	10.08	—	—	—	—	—	—
K1206333-005	20.35	Rocks 2-8mm	349.06	Nitro	10.05	Nitro MS	10.06	Nitro DMS	10.07	TS	10.08	TS DUP	10.08

Comments:

Balance ID: K-BALANCE-42

Prepared By:	Adam Bradbury	Date:	7/9/2012
Reviewed By:	BDK	Date:	7/17/12

17 RB BDK 7/17/12

Nitroaromatics and Nitramines

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Summary Package

Sample and QC Results

COLUMBIA ANALYTICAL SERVICES, INC.
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Client: US Environmental Protection Agency **Service Request:** K1206333
Project: Explosive Residue

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name	Lab Code	Date Collected	Date Received
BS-Soil-061112-01	K1206333-001	06/11/2012	06/30/2012
PD-Comp-B-6-18-2	K1206333-002	06/18/2012	06/30/2012
BS-Sand Fill	K1206333-003	06/19/2012	06/30/2012
PD-V453	K1206333-004	06/22/2012	06/30/2012
PD-Final	K1206333-005	06/28/2012	06/30/2012

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the case narrative. Release of the data contained in this hardcopy data package and in the computer-readable data submitted on floppy diskette has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signature.

Signature: Doug Hadley Name: Doug Hadley

Date: 8/10/12 Title: Scientist

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/11/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	BS-Soil-061112-01	**Units:**	µg/Kg
Lab Code:	K1206333-001	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 04:54	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 04:54	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**11**		2.0	1.1	1	7/ 9/12	7/31/12 04:54	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 04:54	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 04:54	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 04:54	162113	302794	
PETN	**4.2**		2.0	2.0	1	7/ 9/12	7/31/12 04:54	162113	302794	

Surrogate Name	%Rec		Control Limits	Date Analyzed	Q
C13-HMX	63	*	70-130	7/31/12 04:54	
1,3-Dinitrobenzene-C13	83		70-130	7/31/12 04:54	

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6:21 pm, Aug 16, 2012

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Comp-B-6-18-2	**Units:**	µg/Kg
Lab Code:	K1206333-002	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 05:21	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 05:21	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**5.8**		2.0	1.1	1	7/ 9/12	7/31/12 05:21	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 05:21	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 05:21	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 05:21	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 05:21	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	79	70-130	7/31/12 05:21	
1,3-Dinitrobenzene-C13	99	70-130	7/31/12 05:21	

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/19/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	BS-Sand Fill	**Units:**	µg/Kg
Lab Code:	K1206333-003	**Basis:**	Dry
		Percent Solids:	99.6

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 05:48	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 05:48	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 05:48	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 05:48	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 05:48	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 05:48	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 05:48	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	72	70-130	7/31/12 05:48	
1,3-Dinitrobenzene-C13	109	70-130	7/31/12 05:48	

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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/22/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-V453	**Units:**	µg/Kg
Lab Code:	K1206333-004	**Basis:**	Dry
		Percent Solids:	99.6

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 06:14	162113	302794	
RDX	**2.2**		2.0	1.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 06:14	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**2.6**		2.0	1.1	1	7/ 9/12	7/31/12 06:14	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 06:14	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 06:14	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 06:14	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 06:14	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	82	70-130	7/31/12 06:14	
1,3-Dinitrobenzene-C13	105	70-130	7/31/12 06:14	

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COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Final	**Units:**	µg/Kg
Lab Code:	K1206333-005	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**7.0**		2.5	2.5	1	7/ 9/12	7/31/12 06:41	162113	302794	
RDX	**2.9**		2.0	1.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 06:41	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 06:41	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 06:41	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 06:41	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 06:41	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 06:41	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	79	70-130	7/31/12 06:41	
1,3-Dinitrobenzene-C13	95	70-130	7/31/12 06:41	

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COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Sample Name:	Method Blank	**Units:**	µg/Kg
Lab Code:	KQ1207790-05	**Basis:**	Dry

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 08:54	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 08:54	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 08:54	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 08:54	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 08:54	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 08:54	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 08:54	162113	302794	

Surrogate Name	%Rec		Control Limits	Date Analyzed	Q
C13-HMX	67	*	70-130	7/31/12 08:54	
1,3-Dinitrobenzene-C13	73		70-130	7/31/12 08:54	

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6:22 pm, Aug 16, 2012

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil
Service Request: K1206333

Surrogate Recovery Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP
Units: ug/Kg

Sample Name	Lab Code	Sur1	Sur2
BS-Soil-061112-01	K1206333-001	63 *	83
PD-Comp-B-6-18-2	K1206333-002	79	99
BS-Sand Fill	K1206333-003	72	109
PD-V453	K1206333-004	82	105
PD-Final	K1206333-005	79	95
Method Blank	KQ1207790-05	67 *	73
Lab Control Sample	KQ1207790-03	74	77
Duplicate Lab Control Sample	KQ1207790-04	72	109
PD-FinalMS	KQ1207790-01	82	94
PD-FinalDMS	KQ1207790-02	77	87

Surrogate Recovery Control Limits (%)

Sur1	= C13-HMX	70 - 130
Sur2	= 1,3-Dinitrobenzene-C13	70 - 130

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.

Printed 8/10/12 15:27
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Form 2A

SuperSet Reference: 12-0000217118 rev 00

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
		Date Analyzed:	7/31/12

Matrix Spike Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name: PD-Final
Lab Code: K1206333-005

Units: µg/Kg
Basis: Dry

Analytical Method: CAS SOP
Prep Method: CAS SOP

		PD-FinalMS **Matrix Spike** KQ1207790-01				PD-FinalDMS **Duplicate Matrix Spike** KQ1207790-02							
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**		**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**		**RPD Limit**
HMX	ND	80.2	99.9	80		75.8	99.8	76		70 - 130	6		40
RDX	ND	71.1	99.9	71		67.2	99.8	67	*	70 - 130	6		40
1,3,5-Trinitrobenzene	ND	82.9	99.9	83		61.8	99.8	62	*	70 - 130	29		40
1,3-Dinitrobenzene	ND	98.4	99.9	99		86.8	99.8	87		70 - 130	13		40
Tetryl	ND	59.7	99.9	60	*	37.6	99.8	38	*	70 - 130	45	*	40
2,4,6-Trinitrotoluene (TNT)	ND	75.8	99.9	76		82.4	99.8	83		70 - 130	8		40
4-Amino-2,6-dinitrotoluene	ND	90.1	99.9	90		84.4	99.8	85		70 - 130	7		40
2-Amino-4,6-dinitrotoluene	ND	79.8	99.9	80		82.1	99.8	82		70 - 130	3		40
2,4-Dinitrotoluene	ND	81.1	99.9	81		88.8	99.8	89		70 - 130	9		40
2,6-Dinitrotoluene	ND	72.7	99.9	73		114	99.8	114		70 - 130	44	*	40
3,5-Dinitroaniline	ND	80.9	99.9	81		75.0	99.8	75		70 - 130	7		40
PETN	ND	83.7	99.9	84		79.2	99.8	79		70 - 130	5		40

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.
Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil

Service Request: K1206333
Date Analyzed: 7/31/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Units: µg/Kg
Basis: Dry

Extraction Lot: 162113

	Lab Control Sample KQ1207790-03				Duplicate Lab Control Sample KQ1207790-04						
Analyte Name	**Result**	**Spike Amount**	**% Rec**		**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**	**RPD Limit**
HMX	65.6	100	66	*	62.7	100	63	*	70 - 130	5	40
RDX	69.9	100	70		69.2	100	69	*	70 - 130	1	40
1,3,5-Trinitrobenzene	76.3	100	76		75.3	100	75		70 - 130	1	40
1,3-Dinitrobenzene	79.0	100	79		114	100	114		70 - 130	36	40
Tetryl	57.8	100	58	*	69.5	100	70		70 - 130	18	40
2,4,6-Trinitrotoluene (TNT)	79.0	100	79		77.5	100	77		70 - 130	2	40
4-Amino-2,6-dinitrotoluene	81.6	100	82		80.9	100	81		70 - 130	<1	40
2-Amino-4,6-dinitrotoluene	75.5	100	75		74.5	100	74		70 - 130	1	40
2,4-Dinitrotoluene	93.1	100	93		108	100	108		70 - 130	15	40
2,6-Dinitrotoluene	125	100	125		128	100	128		70 - 130	2	40
3,5-Dinitroaniline	75.5	100	76		90.0	100	90		70 - 130	18	40
PETN	91.5	100	92		87.8	100	88		70 - 130	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 08:54
Sample Matrix:	Soil	**Date Extracted:**	7/9/12

Method Blank Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Method Blank	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207790-05	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Method Blank applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
BS-Soil-061112-01	K1206333-001	073012\Spl.wiff	7/31/12 04:54
PD-Comp-B-6-18-2	K1206333-002	073012\Spl.wiff	7/31/12 05:21
BS-Sand Fill	K1206333-003	073012\Spl.wiff	7/31/12 05:48
PD-V453	K1206333-004	073012\Spl.wiff	7/31/12 06:14
PD-Final	K1206333-005	073012\Spl.wiff	7/31/12 06:41
PD-FinalMS	KQ1207790-01	073012\Spl.wiff	7/31/12 07:08
PD-FinalDMS	KQ1207790-02	073012\Spl.wiff	7/31/12 07:34
Lab Control Sample	KQ1207790-03	073012\Spl.wiff	7/31/12 08:01
Duplicate Lab Control Sample	KQ1207790-04	073012\Spl.wiff	7/31/12 08:28

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 08:01
Sample Matrix:	Soil	**Date Extracted:**	7/9/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Lab Control Sample	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207790-03	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Lab Control Sample applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
BS-Soil-061112-01	K1206333-001	073012\Spl.wiff	7/31/12 04:54
PD-Comp-B-6-18-2	K1206333-002	073012\Spl.wiff	7/31/12 05:21
BS-Sand Fill	K1206333-003	073012\Spl.wiff	7/31/12 05:48
PD-V453	K1206333-004	073012\Spl.wiff	7/31/12 06:14
PD-Final	K1206333-005	073012\Spl.wiff	7/31/12 06:41
PD-FinalMS	KQ1207790-01	073012\Spl.wiff	7/31/12 07:08
PD-FinalDMS	KQ1207790-02	073012\Spl.wiff	7/31/12 07:34
Duplicate Lab Control Sample	KQ1207790-04	073012\Spl.wiff	7/31/12 08:28
Method Blank	KQ1207790-05	073012\Spl.wiff	7/31/12 08:54

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date	#	File Location	Acquisition Date
02	073012\Calib.wiff	7/30/12 14:41	03	073012\Calib.wiff	7/30/12 15:08
04	073012\Calib.wiff	7/30/12 15:35	05	073012\Calib.wiff	7/30/12 16:01
06	073012\Calib.wiff	7/30/12 16:28	07	073012\Calib.wiff	7/30/12 16:54
08	073012\Calib.wiff	7/30/12 17:21			

Analyte

HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	9.404E4	03	2.00	9.609E4	04	5.00	9.957E4	05	10.0	1.112E5
06	50.0	1.078E5	07	100.	1.100E5	08	200.	1.127E5			

RDX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.985E4	03	2.00	2.908E4	04	5.00	3.004E4	05	10.0	3.156E4
06	50.0	3.169E4	07	100.	3.084E4	08	200.	3.290E4			

1,3,5-Trinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.481E5	03	2.00	1.595E5	04	5.00	1.760E5	05	10.0	1.810E5
06	50.0	1.817E5	07	100.	1.611E5	08	200.	1.714E5			

1,3-Dinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.706E4	03	2.00	1.905E4	04	5.00	1.746E4	05	10.0	1.751E4
06	50.0	1.708E4	07	100.	1.799E4	08	200.	1.907E4			

Tetryl

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.763E4	03	2.00	2.899E4	04	5.00	2.936E4	05	10.0	3.046E4
06	50.0	2.735E4	07	100.	2.946E4	08	200.	3.037E4			

2,4,6-Trinitrotoluene (TNT)

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.992E5	03	2.00	2.092E5	04	5.00	2.237E5	05	10.0	2.148E5
06	50.0	2.052E5	07	100.	2.040E5	08	200.	2.117E5			

4-Amino-2,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.915E5	03	2.00	2.980E5	04	5.00	3.193E5	05	10.0	3.262E5
06	50.0	3.068E5	07	100.	2.846E5	08	200.	2.783E5			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

Analyte

2-Amino-4,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	7.461E5	03	2.00	7.928E5	04	5.00	8.506E5	05	10.0	8.428E5
06	50.0	7.692E5	07	100.	6.518E5	08	200.	5.264E5			

2,4-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	605.0	03	2.00	658.5	04	5.00	739.5	05	10.0	723.6
06	50.0	805.2	07	100.	751.6	08	200.	841.6			

2,6-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1,363	03	2.00	1,273	04	5.00	1,660	05	10.0	1,684
06	50.0	1,790	07	100.	1,647	08	200.	2,073			

3,5-Dinitroaniline

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.309E5	03	2.00	1.400E5	04	5.00	1.435E5	05	10.0	1.510E5
06	50.0	1.481E5	07	100.	1.438E5	08	200.	1.442E5			

PETN

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	8,939	03	2.00	8,985	04	5.00	9,398	05	10.0	9,423
06	50.0	9,636	07	100.	9,745	08	200.	1.061E4			

C13-HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	3.753E4	03	2.00	3.852E4	04	5.00	3.957E4	05	10.0	4.467E4
06	50.0	4.414E4	07	100.	4.577E4	08	200.	4.968E4			

1,3-Dinitrobenzene-C13

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.720E4	03	2.00	2.944E4	04	5.00	2.628E4	05	10.0	2.853E4
06	50.0	2.809E4	07	100.	2.835E4	08	200.	3.124E4			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

		Calibration Evaluation					RRF Evaluation		
Analyte Name	**Compound Type**	**Fit Type**	**Eval.**	**Eval. Result**	**Q**	**Control Criteria**	**Average RRF**	**Q**	**Minimum RRF**
HMX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
RDX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
1,3,5-Trinitrobenzene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
1,3-Dinitrobenzene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
Tetryl	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2,4,6-Trinitrotoluene (TNT)	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
4-Amino-2,6-dinitrotoluene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2-Amino-4,6-dinitrotoluene	TRG	Quadratic	COD	0.999		≥ 0.990	NA		
2,4-Dinitrotoluene	TRG	Linear	R2	0.997		≥ 0.990	NA		
2,6-Dinitrotoluene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
3,5-Dinitroaniline	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
PETN	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
C13-HMX	SURR	Quadratic	COD	1.000		≥ 0.990	NA		
1,3-Dinitrobenzene-C13	SURR	Quadratic	COD	1.000		≥ 0.990	NA		

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Verfication Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date
40	073012\Calib.wiff	7/30/12 18:41

Analyte Name	Expected	Result	Average RF	SSV RF	%D	Criteria	Curve Fit
HMX	100.	112.780	1.045E5	1.244E5	12.78	±30	Quadratic
RDX	100.	109.539	3.085E4	3.469E4	9.54	±30	Quadratic
1,3,5-Trinitrobenzene	100.	113.984	1.684E5	1.945E5	13.98	±30	Quadratic
1,3-Dinitrobenzene	100.	125.197	1.789E4	2.279E4	25.20	±30	Quadratic
Tetryl	100.	121.625	2.909E4	3.573E4	21.63	±30	Quadratic
2,4,6-Trinitrotoluene (TNT)	100.	122.828	2.097E5	2.554E5	22.83	±30	Quadratic
4-Amino-2,6-dinitrotoluene	100.	114.681	3.007E5	3.331E5	14.68	±30	Quadratic
2-Amino-4,6-dinitrotoluene	100.	118.245	7.400E5	7.645E5	18.24	±30	Quadratic
2,4-Dinitrotoluene	100.	112.377	732.1	909.2	12.38	±30	Linear
2,6-Dinitrotoluene	100.	117.310	1,641	2,146	17.31	±30	Quadratic
3,5-Dinitroaniline	100.	112.234	1.431E5	1.633E5	12.23	±30	Quadratic
PETN	100.	111.426	9,534	1.109E4	11.43	±30	Quadratic
C13-HMX	100.	105.792	4.284E4	4.890E4	5.79	±30	Quadratic
1,3-Dinitrobenzene-C13	100.	116.671	2.845E4	3.410E4	16.67	±30	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	113	NA	NA	NA	12.8	± 30 %	Quadratic
RDX	100	110	NA	NA	NA	9.5	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	114	NA	NA	NA	14.0	± 30 %	Quadratic
1,3-Dinitrobenzene	100	125	NA	NA	NA	25.2	± 30 %	Quadratic
Tetryl	100	122	NA	NA	NA	21.6	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	123	NA	NA	NA	22.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	115	NA	NA	NA	14.7	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	118	NA	NA	NA	18.2	± 30 %	Quadratic
2,4-Dinitrotoluene	100	112	NA	NA	NA	12.4	± 30 %	Linear
2,6-Dinitrotoluene	100	117	NA	NA	NA	17.3	± 30 %	Quadratic
3,5-Dinitroaniline	100	112	NA	NA	NA	12.2	± 30 %	Quadratic
C13-HMX	100	106	NA	NA	NA	5.8	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	117	NA	NA	NA	16.7	± 30 %	Quadratic
PETN	100	111	NA	NA	NA	11.4	± 30 %	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	95.3	NA	NA	NA	-4.7	± 30 %	Quadratic
RDX	100	86.6	NA	NA	NA	-13.4	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	99.1	NA	NA	NA	-0.9	± 30 %	Quadratic
1,3-Dinitrobenzene	100	106	NA	NA	NA	6.2	± 30 %	Quadratic
Tetryl	100	96.9	NA	NA	NA	-3.1	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	104	NA	NA	NA	3.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	99.5	NA	NA	NA	-0.5	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	100	NA	NA	NA	0.0	± 30 %	Quadratic
2,4-Dinitrotoluene	100	83.1	NA	NA	NA	-16.9	± 30 %	Linear
2,6-Dinitrotoluene	100	115	NA	NA	NA	15.0	± 30 %	Quadratic
3,5-Dinitroaniline	100	99.0	NA	NA	NA	-1.0	± 30 %	Quadratic
C13-HMX	100	91.7	NA	NA	NA	-8.3	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	103	NA	NA	NA	3.0	± 30 %	Quadratic
PETN	100	95.9	NA	NA	NA	-4.1	± 30 %	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/31/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	85.2	NA	NA	NA	-14.8	± 30 %	Quadratic
RDX	100	80.8	NA	NA	NA	-19.2	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	94.4	NA	NA	NA	-5.6	± 30 %	Quadratic
1,3-Dinitrobenzene	100	101	NA	NA	NA	0.9	± 30 %	Quadratic
Tetryl	100	94.6	NA	NA	NA	-5.4	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	100	NA	NA	NA	0.1	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	98.8	NA	NA	NA	-1.2	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	95.6	NA	NA	NA	-4.4	± 30 %	Quadratic
2,4-Dinitrotoluene	100	104	NA	NA	NA	3.8	± 30 %	Linear
2,6-Dinitrotoluene	100	106	NA	NA	NA	5.7	± 30 %	Quadratic
3,5-Dinitroaniline	100	94.2	NA	NA	NA	-5.8	± 30 %	Quadratic
C13-HMX	100	84.3	NA	NA	NA	-15.7	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	101	NA	NA	NA	0.6	± 30 %	Quadratic
PETN	100	93.3	NA	NA	NA	-6.7	± 30 %	Quadratic

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333

Analysis Run Log
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

Analysis Lot: 302794
Instrument ID: K-LCMS-02

Raw Data File	Sample Name	Lab Code	Date Analyzed	Time Analyzed	Q
Calib.wiff	Continuing Cal. Verification	KQ1208851-01	7/30/12	18:41	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	19:08	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	19:35	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	20:01	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	20:28	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	20:54	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	21:21	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	21:48	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	22:14	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	22:41	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/30/12	23:08	
Calib.wiff	Continuing Cal. Verification	KQ1208851-02	7/30/12	23:34	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	00:01	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	00:28	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	00:54	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	01:21	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	01:48	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	02:14	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	02:41	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	03:08	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	03:34	
Spl.wiff	ZZZZZZZ	ZZZZZZZ	7/31/12	04:01	
Calib.wiff	Continuing Cal. Verification	KQ1208851-03	7/31/12	04:28	
Spl.wiff	BS-Soil-061112-01	K1206333-001	7/31/12	04:54	
Spl.wiff	PD-Comp-B-6-18-2	K1206333-002	7/31/12	05:21	
Spl.wiff	BS-Sand Fill	K1206333-003	7/31/12	05:48	
Spl.wiff	PD-V453	K1206333-004	7/31/12	06:14	
Spl.wiff	PD-Final	K1206333-005	7/31/12	06:41	
Spl.wiff	PD-FinalMS	KQ1207790-01	7/31/12	07:08	
Spl.wiff	PD-FinalDMS	KQ1207790-02	7/31/12	07:34	
Spl.wiff	Lab Control Sample	KQ1207790-03	7/31/12	08:01	
Spl.wiff	Duplicate Lab Control Sample	KQ1207790-04	7/31/12	08:28	
Spl.wiff	Method Blank	KQ1207790-05	7/31/12	08:54	
Calib.wiff	Continuing Cal. Verification	KQ1208851-04	7/31/12	09:21	

Results flagged with an asterisk (*) indicate the holding time was exceeded for the analysis

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Prep Summary Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil

Service Request: K1206333

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Prep Method: CAS SOP
Analytical Method: CAS SOP

Extraction Lot: 162113

Sample Name	Lab Code	Date Collected	Date Received	Sample Amount	Final Amount	Percent Solids
BS-Soil-061112-01	K1206333-001	6/11/12	6/30/12	10.0600 g	20 mL	99.5
PD-Comp-B-6-18-2	K1206333-002	6/18/12	6/30/12	10.0500 g	20 mL	99.5
BS-Sand Fill	K1206333-003	6/19/12	6/30/12	10.0500 g	20 mL	99.6
PD-V453	K1206333-004	6/22/12	6/30/12	10.0400 g	20 mL	99.6
PD-Final	K1206333-005	6/28/12	6/30/12	10.0500 g	20 mL	99.5
Method Blank	KQ1207790-05			10.0700 g	20 mL	
Lab Control Sample	KQ1207790-03			10.0000 g	20 mL	
Duplicate Lab Control Sample	KQ1207790-04			10.0000 g	20 mL	
PD-FinalMS	KQ1207790-01	6/28/12	6/30/12	10.0600 g	20 mL	99.5
PD-FinalDMS	KQ1207790-02	6/28/12	6/30/12	10.0700 g	20 mL	99.5

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

QC Reports

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil
Service Request: K1206333

Surrogate Recovery Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP
Units: ug/Kg

Sample Name	Lab Code	Sur1	Sur2
BS-Soil-061112-01	K1206333-001	63 *	83
PD-Comp-B-6-18-2	K1206333-002	79	99
BS-Sand Fill	K1206333-003	72	109
PD-V453	K1206333-004	82	105
PD-Final	K1206333-005	79	95
Method Blank	KQ1207790-05	67 *	73
Lab Control Sample	KQ1207790-03	74	77
Duplicate Lab Control Sample	KQ1207790-04	72	109
PD-FinalMS	KQ1207790-01	82	94
PD-FinalDMS	KQ1207790-02	77	87

Surrogate Recovery Control Limits (%)

Sur1	=	C13-HMX	70 - 130
Sur2	=	1,3-Dinitrobenzene-C13	70 - 130

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
		Date Analyzed:	7/31/12

Matrix Spike Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name: PD-Final
Lab Code: K1206333-005

Units: µg/Kg
Basis: Dry

Analytical Method: CAS SOP
Prep Method: CAS SOP

		PD-FinalMS **Matrix Spike** KQ1207790-01				PD-FinalDMS **Duplicate Matrix Spike** KQ1207790-02						
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**		**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**		**RPD Limit**
HMX	ND	80.2	99.9	80		75.8	99.8	76		70 - 130	6		40
RDX	ND	71.1	99.9	71		67.2	99.8	67	*	70 - 130	6		40
1,3,5-Trinitrobenzene	ND	82.9	99.9	83		61.8	99.8	62	*	70 - 130	29		40
1,3-Dinitrobenzene	ND	98.4	99.9	99		86.8	99.8	87		70 - 130	13		40
Tetryl	ND	59.7	99.9	60	*	37.6	99.8	38	*	70 - 130	45	*	40
2,4,6-Trinitrotoluene (TNT)	ND	75.8	99.9	76		82.4	99.8	83		70 - 130	8		40
4-Amino-2,6-dinitrotoluene	ND	90.1	99.9	90		84.4	99.8	85		70 - 130	7		40
2-Amino-4,6-dinitrotoluene	ND	79.8	99.9	80		82.1	99.8	82		70 - 130	3		40
2,4-Dinitrotoluene	ND	81.1	99.9	81		88.8	99.8	89		70 - 130	9		40
2,6-Dinitrotoluene	ND	72.7	99.9	73		114	99.8	114		70 - 130	44	*	40
3,5-Dinitroaniline	ND	80.9	99.9	81		75.0	99.8	75		70 - 130	7		40
PETN	ND	83.7	99.9	84		79.2	99.8	79		70 - 130	5		40

Results flagged with an asterisk (*) indicate values outside control criteria.
Results flagged with a pound (#) indicate the control criteria is not applicable.
Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue
Sample Matrix: Soil

Service Request: K1206333
Date Analyzed: 7/31/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Units: µg/Kg
Basis: Dry

Extraction Lot: 162113

	Lab Control Sample KQ1207790-03				Duplicate Lab Control Sample KQ1207790-04						
Analyte Name	**Result**	**Spike Amount**	**% Rec**		**Result**	**Spike Amount**	**% Rec**		**% Rec Limits**	**RPD**	**RPD Limit**
HMX	65.6	100	66	*	62.7	100	63	*	70 - 130	5	40
RDX	69.9	100	70		69.2	100	69	*	70 - 130	1	40
1,3,5-Trinitrobenzene	76.3	100	76		75.3	100	75		70 - 130	1	40
1,3-Dinitrobenzene	79.0	100	79		114	100	114		70 - 130	36	40
Tetryl	57.8	100	58	*	69.5	100	70		70 - 130	18	40
2,4,6-Trinitrotoluene (TNT)	79.0	100	79		77.5	100	77		70 - 130	2	40
4-Amino-2,6-dinitrotoluene	81.6	100	82		80.9	100	81		70 - 130	<1	40
2-Amino-4,6-dinitrotoluene	75.5	100	75		74.5	100	74		70 - 130	1	40
2,4-Dinitrotoluene	93.1	100	93		108	100	108		70 - 130	15	40
2,6-Dinitrotoluene	125	100	125		128	100	128		70 - 130	2	40
3,5-Dinitroaniline	75.5	100	76		90.0	100	90		70 - 130	18	40
PETN	91.5	100	92		87.8	100	88		70 - 130	4	40

Results flagged with an asterisk (*) indicate values outside control criteria.
Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 08:54
Sample Matrix:	Soil	**Date Extracted:**	7/9/12

Method Blank Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Method Blank	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207790-05	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Method Blank applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
BS-Soil-061112-01	K1206333-001	073012\Spl.wiff	7/31/12 04:54
PD-Comp-B-6-18-2	K1206333-002	073012\Spl.wiff	7/31/12 05:21
BS-Sand Fill	K1206333-003	073012\Spl.wiff	7/31/12 05:48
PD-V453	K1206333-004	073012\Spl.wiff	7/31/12 06:14
PD-Final	K1206333-005	073012\Spl.wiff	7/31/12 06:41
PD-FinalMS	KQ1207790-01	073012\Spl.wiff	7/31/12 07:08
PD-FinalDMS	KQ1207790-02	073012\Spl.wiff	7/31/12 07:34
Lab Control Sample	KQ1207790-03	073012\Spl.wiff	7/31/12 08:01
Duplicate Lab Control Sample	KQ1207790-04	073012\Spl.wiff	7/31/12 08:28

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Analyzed:**	7/31/12 08:01
Sample Matrix:	Soil	**Date Extracted:**	7/9/12

Lab Control Sample Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Sample Name:	Lab Control Sample	**Instrument ID:**	K-LCMS-02
Lab Code:	KQ1207790-03	**File ID:**	073012\Spl.wiff
Analytical Method:	CAS SOP		
Prep Method:	CAS SOP		

This Lab Control Sample applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed
BS-Soil-061112-01	K1206333-001	073012\Spl.wiff	7/31/12 04:54
PD-Comp-B-6-18-2	K1206333-002	073012\Spl.wiff	7/31/12 05:21
BS-Sand Fill	K1206333-003	073012\Spl.wiff	7/31/12 05:48
PD-V453	K1206333-004	073012\Spl.wiff	7/31/12 06:14
PD-Final	K1206333-005	073012\Spl.wiff	7/31/12 06:41
PD-FinalMS	KQ1207790-01	073012\Spl.wiff	7/31/12 07:08
PD-FinalDMS	KQ1207790-02	073012\Spl.wiff	7/31/12 07:34
Duplicate Lab Control Sample	KQ1207790-04	073012\Spl.wiff	7/31/12 08:28
Method Blank	KQ1207790-05	073012\Spl.wiff	7/31/12 08:54

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Raw Data

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/11/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	BS-Soil-061112-01	**Units:**	µg/Kg
Lab Code:	K1206333-001	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 04:54	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 04:54	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**11**		2.0	1.1	1	7/ 9/12	7/31/12 04:54	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 04:54	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 04:54	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 04:54	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 04:54	162113	302794	
PETN	**4.2**		2.0	2.0	1	7/ 9/12	7/31/12 04:54	162113	302794	

Surrogate Name	%Rec		Control Limits	Date Analyzed	Q
C13-HMX	63	*	70-130	7/31/12 04:54	
1,3-Dinitrobenzene-C13	83		70-130	7/31/12 04:54	

REVISED
6:22 pm, Aug 16, 2012

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

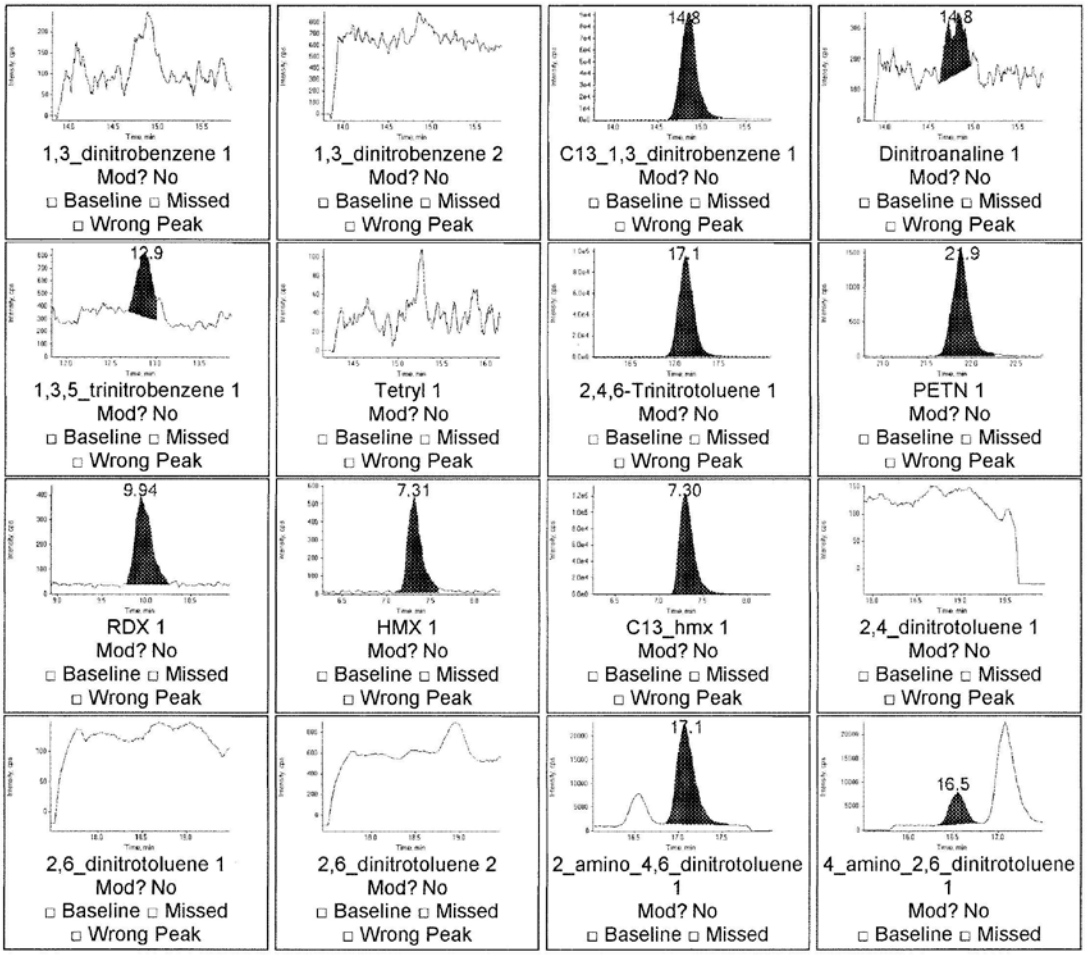
Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	K1206333-001	**Injection Volume**	100
Acquisition Date	7/31/2012 4:54:46 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	31	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1142900	41.50	No
Dinitroanaline 1	14.80 (14.80)	2593	0.11	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	5967	0.11	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	1120200	5.43	No
PETN 1	21.90 (21.80)	19090	2.08	No
RDX 1	9.94 (9.93)	4507	0.17	No
HMX 1	7.31 (7.28)	5742	0.21	No
C13_hmx 1	7.30 (7.25)	1370600	31.60	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	297490	0.39	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	83059	0.27	No

Quantitative Peak Review K1206333-001



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/18/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Comp-B-6-18-2	**Units:**	µg/Kg
Lab Code:	K1206333-002	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 05:21	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 05:21	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**5.8**		2.0	1.1	1	7/ 9/12	7/31/12 05:21	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 05:21	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 05:21	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 05:21	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 05:21	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 05:21	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	79	70-130	7/31/12 05:21	
1,3-Dinitrobenzene-C13	99	70-130	7/31/12 05:21	

REVISED
6:22 pm, Aug 16, 2012

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

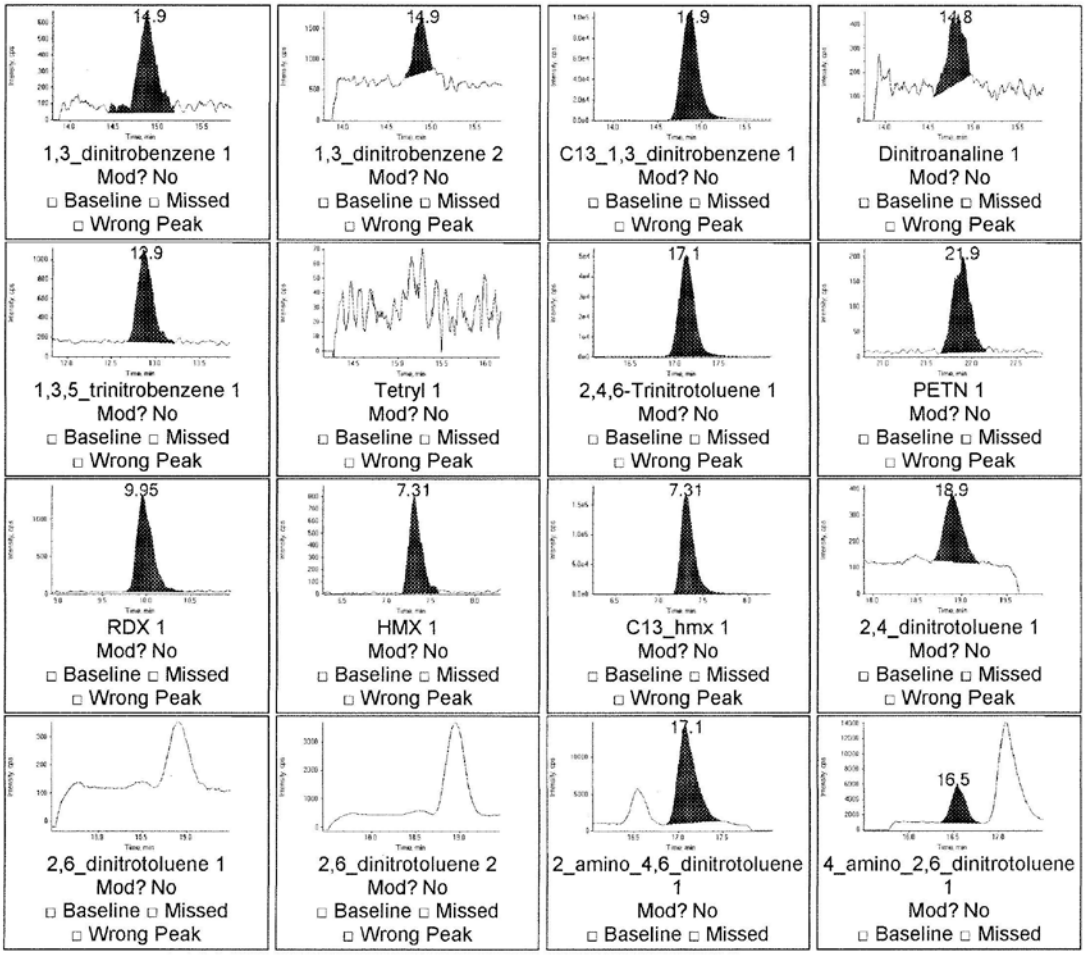
Sample Name	K1206333-002	**Injection Volume**	100
Acquisition Date	7/31/2012 5:21:25 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	32	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	8734	0.40	No
1,3_dinitrobenzene 2	14.90 (14.80)	9068	0.19	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1377300	49.70	No
Dinitroanaline 1	14.80 (14.80)	3747	0.12	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	11428	0.14	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	604660	2.89	No
PETN 1	21.90 (21.80)	2521	0.28	No
RDX 1	9.95 (9.93)	15394	0.52	No
HMX 1	7.31 (7.28)	7703	0.23	No
C13_hmx 1	7.31 (7.25)	1726000	39.50	No
2,4_dinitrotoluene 1	18.90 (18.90)	3595	4.80	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	184220	0.25	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	56750	0.18	No

Mel Stroka 8/2/12

Quantitative Peak Review K1206333-002



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/19/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	BS-Sand Fill	**Units:**	µg/Kg
Lab Code:	K1206333-003	**Basis:**	Dry
		Percent Solids:	99.6

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 05:48	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 05:48	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 05:48	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 05:48	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 05:48	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 05:48	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 05:48	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 05:48	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	72	70-130	7/31/12 05:48	
1,3-Dinitrobenzene-C13	109	70-130	7/31/12 05:48	

REVISED
6:23 pm, Aug 16, 2012

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

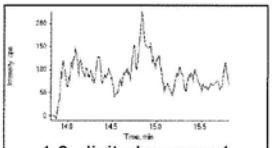
Sample Name	K1206333-003	**Injection Volume**	100
Acquisition Date	7/31/2012 5:48:04 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	33	**Weight to Volume**	0.00

Results Summary

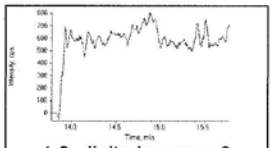
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1510200	54.30	No
Dinitroanaline 1	14.80 (14.80)	5372	0.13	No
1,3,5_trinitrobenzene 1	0.00 (12.80)	0	N/A	Yes qrd
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	20369	0.01	No
PETN 1	21.80 (21.80)	590	0.07	No
RDX 1	9.99 (9.93)	2661	0.10	No
HMX 1	7.31 (7.28)	3494	0.19	No
C13_hmx 1	7.29 (7.25)	1577800	36.20	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	Yes qrdl
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	33575	0.07	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	10917	0.03	No

MLL 8/10/12
8/2/12

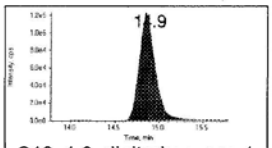
Quantitative Peak Review K1206333-003



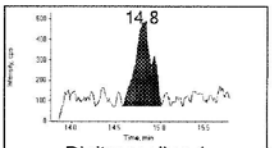
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



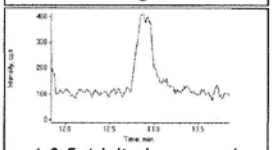
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



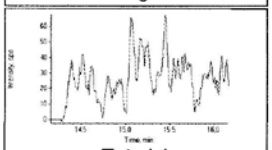
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



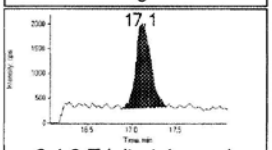
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



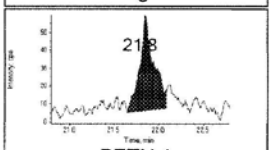
1,3,5_trinitrobenzene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



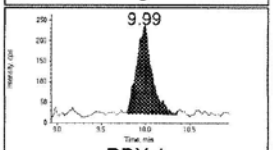
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



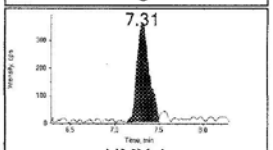
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



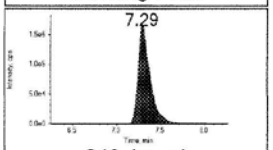
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



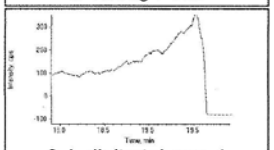
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



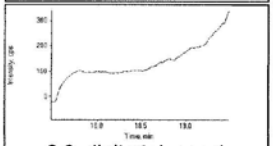
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



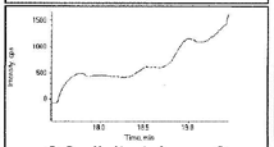
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



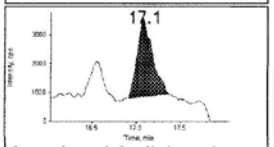
2,4_dinitrotoluene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



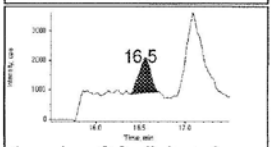
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/22/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-V453	**Units:**	µg/Kg
Lab Code:	K1206333-004	**Basis:**	Dry
		Percent Solids:	99.6

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 06:14	162113	302794	
RDX	**2.2**		2.0	1.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 06:14	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**2.6**		2.0	1.1	1	7/ 9/12	7/31/12 06:14	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 06:14	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 06:14	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 06:14	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 06:14	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 06:14	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	82	70-130	7/31/12 06:14	
1,3-Dinitrobenzene-C13	105	70-130	7/31/12 06:14	

REVISED
6:23 pm, Aug 16, 2012

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

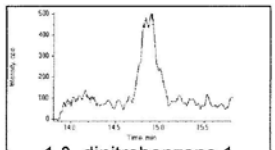
Sample Name	K1206333-004	**Injection Volume**	100
Acquisition Date	7/31/2012 6:14:43 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	34	**Weight to Volume**	0.00

Results Summary

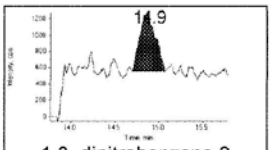
Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	Yes
1,3_dinitrobenzene 2	14.90 (14.80)	9087	0.19	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1464500	52.70	No
Dinitroanaline 1	14.80 (14.80)	5358	0.13	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	23883	0.21	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	276820	1.28	No
PETN 1	21.80 (21.80)	1273	0.14	No
RDX 1	9.96 (9.93)	33204	1.11	No
HMX 1	7.31 (7.28)	28496	0.42	No
C13_hmx 1	7.30 (7.25)	1795200	41.00	No
2,4_dinitrotoluene 1	18.90 (18.90)	3128	4.23	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	256110	0.34	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	32162	0.10	No

8/10/12 8/2/12

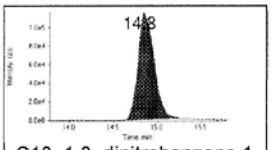
Quantitative Peak Review K1206333-004



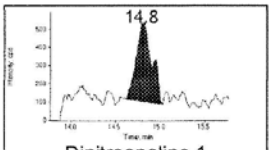
1,3_dinitrobenzene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



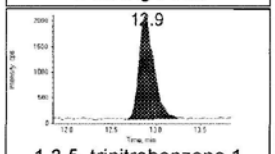
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



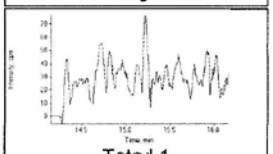
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



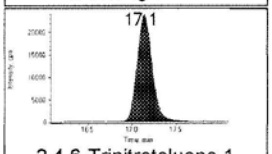
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



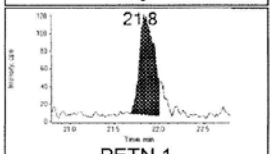
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



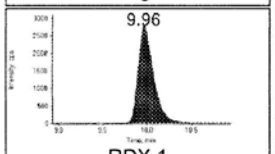
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



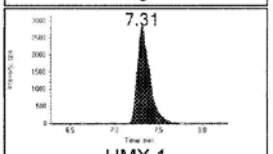
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



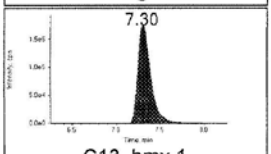
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



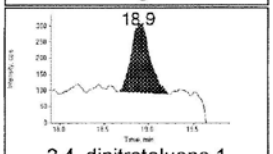
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



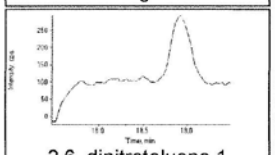
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



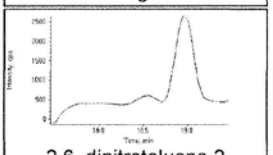
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



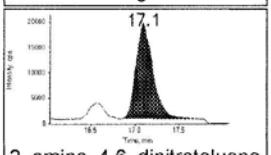
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



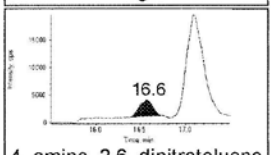
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Final	**Units:**	µg/Kg
Lab Code:	K1206333-005	**Basis:**	Dry
		Percent Solids:	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**7.0**		2.5	2.5	1	7/ 9/12	7/31/12 06:41	162113	302794	
RDX	**2.9**		2.0	1.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 06:41	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 06:41	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 06:41	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 06:41	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 06:41	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 06:41	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 06:41	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	79	70-130	7/31/12 06:41	
1,3-Dinitrobenzene-C13	95	70-130	7/31/12 06:41	

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6:23 pm, Aug 16, 2012

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

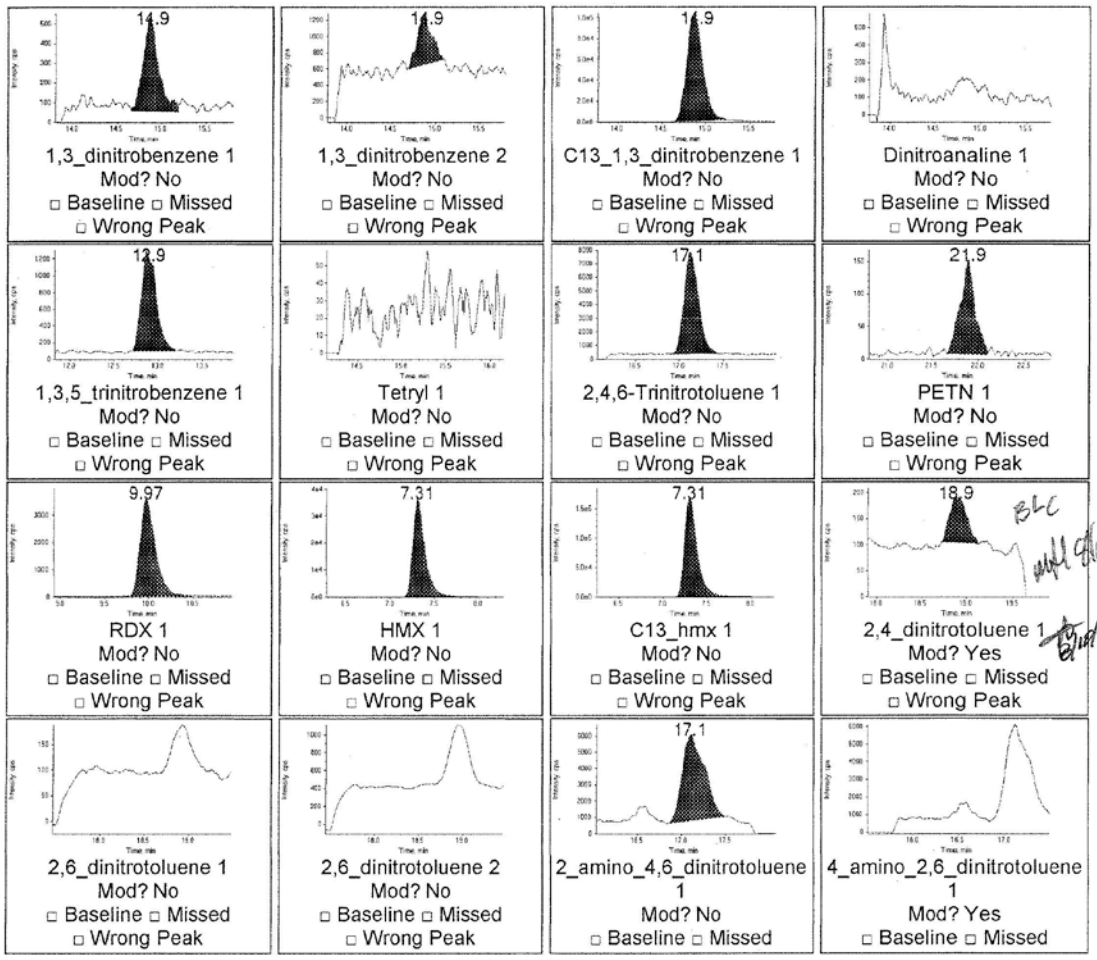
Sample Name	K1206333-005	**Injection Volume**	100
Acquisition Date	7/31/2012 6:41:22 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	35	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	5963	0.23	No
1,3_dinitrobenzene 2	14.90 (14.80)	7364	0.13	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1317500	47.60	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	14452	0.15	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	87463	0.34	No
PETN 1	21.90 (21.80)	1613	0.18	No
RDX 1	9.97 (9.93)	43500	1.45	No
HMX 1	7.31 (7.28)	358070	3.48	No
C13_hmx 1	7.31 (7.25)	1721500	39.40	No
2,4_dinitrotoluene 1	18.90 (18.90)	1136	1.77	Yes
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	93594	0.15	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	Yes

8/10/11 8/2/11

Quantitative Peak Review K1206333-005



☐ Before ☐ After

Polarity/Scan Type: N/A
*Pre PM TESTING

*Tom Westlake. Senior FSE, AB Sciex
**API5000 SN: AG22300804

Printing Time: 9:53:11 AM
Printing Date: Thursday, August 02, 2012

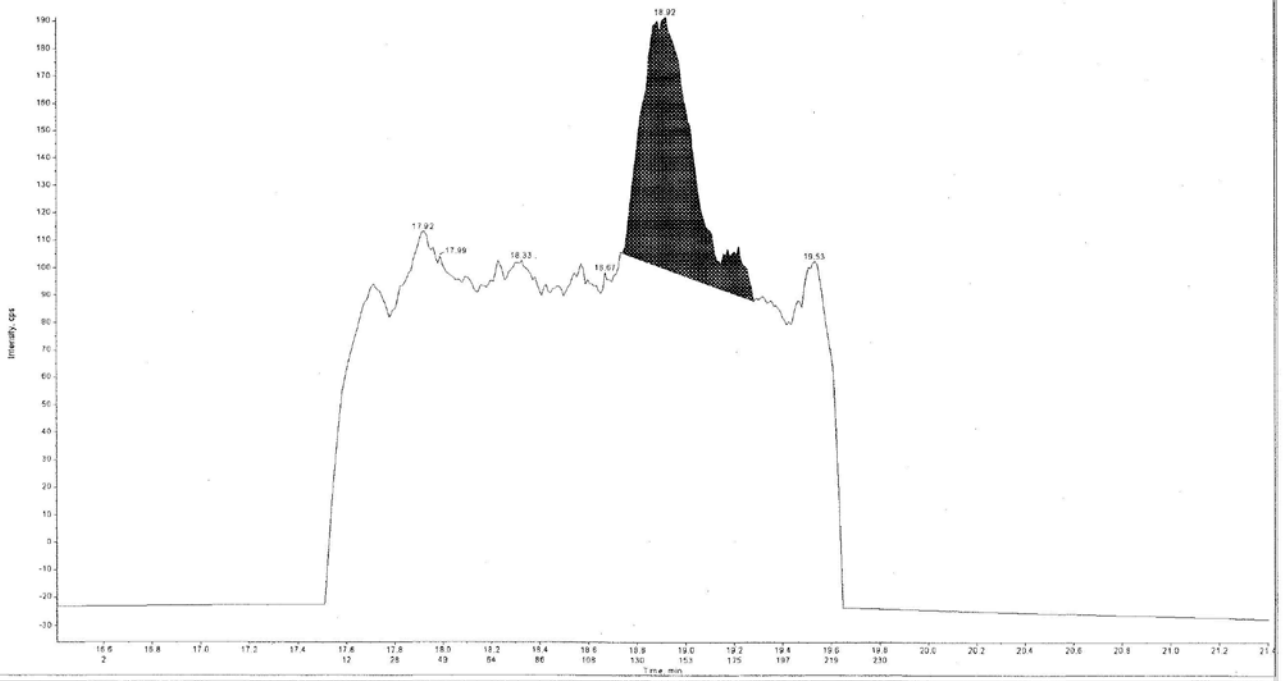
	File Name	Sample Name	Sample Type	Analyte Peak Name	Analyte Peak Area (counts)	Analyte Concentration (ng/mL)	Calculated Concentration (ng/mL)
1084	073012\Spl.wiff	K1206333-005	Unknown	C13_hmx 2	536120.	N/A	39.4
1085	073012\Spl.wiff	K1206333-005	Unknown	2,4_dinitrotoluene 1	1347.3	N/A	2.03
1086	073012\Spl.wiff	K1206333-005	Unknown	2,4_dinitrotoluene 2	109830.	N/A	0.241
1087	073012\Spl.wiff	K1206333-005	Unknown	2,6_dinitrotoluene 1	0.0000	N/A	No Peak

Sample Name: K1206333-005 Sample ID: "PM1PM8" File: "Spl.wiff"
Peak Name: "2,4_dinitrotoluene 1" Mass(es): "187.010/152.000 Da"
Comment: "" Annotation: ""

Sample Index: 25
Sample Type: Unknown
Concentration: N/A
Calculated Conc: 2.03 ng/mL
Acq. Date: 7/31/2012
Acq. Time: 6:41:22 AM

Modified: No
Proc. Algorithm: Specify Parameters - MQ III
Noise Percentage: 50
Base. Sub. Window: 0.80 min
Peak-Split. Factor: 4
Report Largest Peak: No
Min. Peak Height: 50.00 cps
Min. Peak Width: 0.00 sec
Smoothing Width: 29 points
RT Window: 38.0 sec
Expected RT: 18.9 min
Use Relative RT: No

Int. Type: Base To Base
Retention Time: 18.9 min
Area: 1341.3 counts
Height: 92.483 cps
Start Time: 18.7 min
End Time: 19.2 min



COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Sample Name:	Method Blank	**Units:**	µg/Kg
Lab Code:	KQ1207790-05	**Basis:**	Dry

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	ND	U	2.5	2.5	1	7/ 9/12	7/31/12 08:54	162113	302794	
RDX	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
1,3,5-Trinitrobenzene	ND	U	2.8	2.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
1,3-Dinitrobenzene	ND	U	6.2	6.2	1	7/ 9/12	7/31/12 08:54	162113	302794	
Tetryl	ND	U	2.0	1.8	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,4,6-Trinitrotoluene (TNT)	ND	U	2.0	1.1	1	7/ 9/12	7/31/12 08:54	162113	302794	
4-Amino-2,6-dinitrotoluene	ND	U	2.0	1.6	1	7/ 9/12	7/31/12 08:54	162113	302794	
2-Amino-4,6-dinitrotoluene	ND	U	2.0	0.90	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,4-Dinitrotoluene	ND	U	12	12	1	7/ 9/12	7/31/12 08:54	162113	302794	
2,6-Dinitrotoluene	ND	U	6.9	6.9	1	7/ 9/12	7/31/12 08:54	162113	302794	
3,5-Dinitroaniline	ND	U	2.0	1.2	1	7/ 9/12	7/31/12 08:54	162113	302794	
PETN	ND	U	2.0	2.0	1	7/ 9/12	7/31/12 08:54	162113	302794	

Surrogate Name	%Rec		Control Limits	Date Analyzed	Q
C13-HMX	67	*	70-130	7/31/12 08:54	
1,3-Dinitrobenzene-C13	73		70-130	7/31/12 08:54	

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6:23 pm, Aug 16, 2012

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

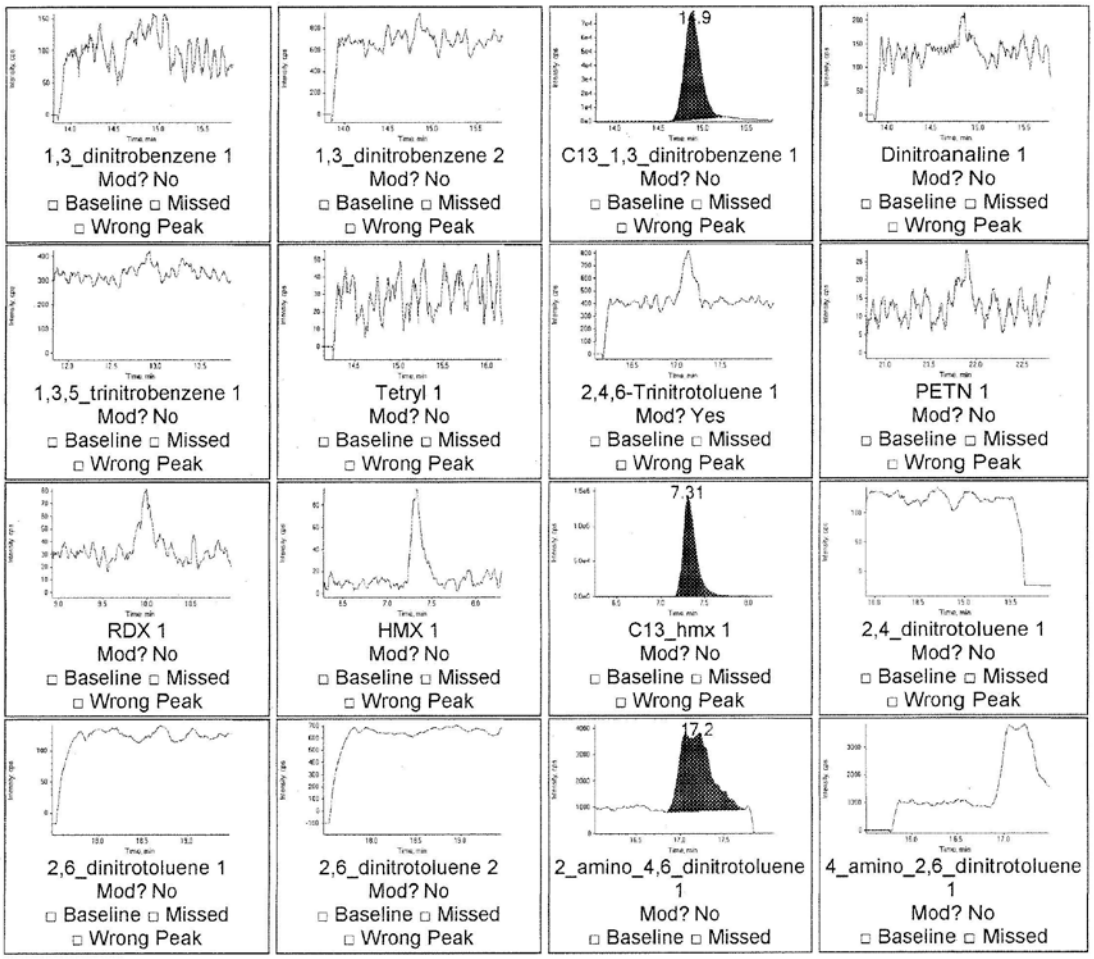
MB

Sample Name	KQ1207790-05	**Injection Volume**	100
Acquisition Date	7/31/2012 8:54:43 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	40	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	999330	36.40	No
Dinitroanaline 1	0.00 (14.80)	0	N/A	No
1,3,5_trinitrobenzene 1	0.00 (12.80)	0	N/A	No
Tetryl 1	0.00 (15.20)	0	N/A	No
2,4,6-Trinitrotoluene 1	0.00 (17.10)	0	N/A	Yes
PETN 1	0.00 (21.80)	0	N/A	No
RDX 1	0.00 (9.93)	0	N/A	No
HMX 1	0.00 (7.28)	0	N/A	No
C13_hmx 1	7.31 (7.25)	1451300	33.40	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.20 (17.00)	76387	0.12	No
4_amino_2,6_dinitrotoluene 1	0.00 (16.50)	0	N/A	No

Quantitative Peak Review KQ1207790-05



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Sample Name:	Lab Control Sample	**Units:**	µg/Kg
Lab Code:	KQ1207790-03	**Basis:**	Dry

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**65.6**		2.5	2.5	1	7/ 9/12	7/31/12 08:01	162113	302794	
RDX	**69.9**		2.0	1.8	1	7/ 9/12	7/31/12 08:01	162113	302794	
1,3,5-Trinitrobenzene	**76.3**		2.8	2.8	1	7/ 9/12	7/31/12 08:01	162113	302794	
1,3-Dinitrobenzene	**79.0**		6.2	6.2	1	7/ 9/12	7/31/12 08:01	162113	302794	
Tetryl	**57.8**		2.0	1.8	1	7/ 9/12	7/31/12 08:01	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**79.0**		2.0	1.1	1	7/ 9/12	7/31/12 08:01	162113	302794	
4-Amino-2,6-dinitrotoluene	**81.6**		2.0	1.6	1	7/ 9/12	7/31/12 08:01	162113	302794	
2-Amino-4,6-dinitrotoluene	**75.5**		2.0	0.90	1	7/ 9/12	7/31/12 08:01	162113	302794	
2,4-Dinitrotoluene	**93.1**		12	12	1	7/ 9/12	7/31/12 08:01	162113	302794	
2,6-Dinitrotoluene	**125**		6.9	6.9	1	7/ 9/12	7/31/12 08:01	162113	302794	
3,5-Dinitroaniline	**75.5**		2.0	1.2	1	7/ 9/12	7/31/12 08:01	162113	302794	
PETN	**91.5**		2.0	2.0	1	7/ 9/12	7/31/12 08:01	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	74	70-130	7/31/12 08:01	
1,3-Dinitrobenzene-C13	77	70-130	7/31/12 08:01	

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6:23 pm, Aug 16, 2012

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

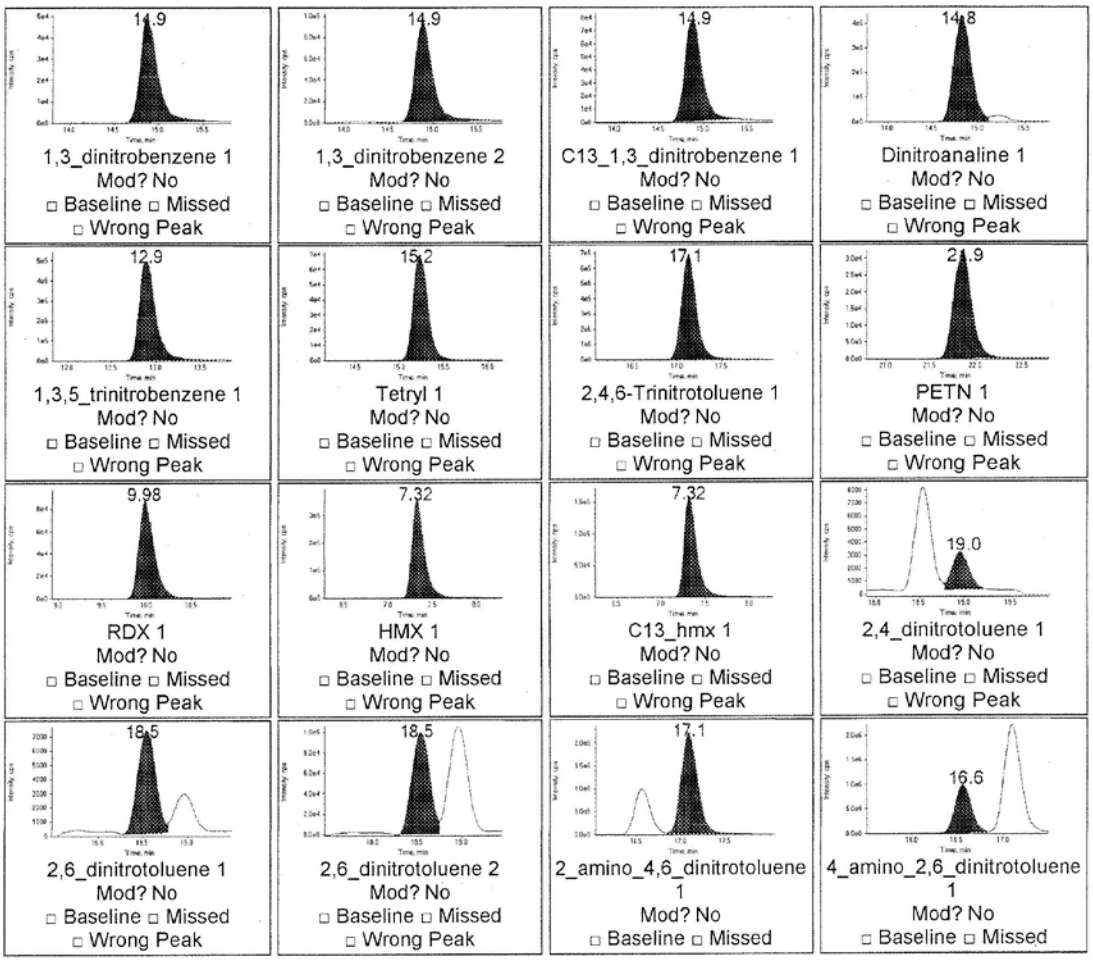
Sample Name	KQ1207790-03	**Injection Volume**	100
Acquisition Date	7/31/2012 8:01:22 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	38	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	681060	39.50	No
1,3_dinitrobenzene 2	14.90 (14.80)	1300600	39.70	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1057200	38.50	No
Dinitroanaline 1	14.80 (14.80)	5539900	37.80	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	6539900	38.20	No
Tetryl 1	15.20 (15.20)	816340	28.90	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	8092600	39.50	No
PETN 1	21.90 (21.80)	434170	45.70	No
RDX 1	9.98 (9.93)	1075200	35.00	No
HMX 1	7.32 (7.28)	3535200	32.80	No
C13_hmx 1	7.32 (7.25)	1606500	36.80	No
2,4_dinitrotoluene 1	19.00 (18.90)	37478	46.50	No
2,6_dinitrotoluene 1	18.50 (18.50)	105050	62.40	No
2,6_dinitrotoluene 2	18.50 (18.50)	1409700	61.30	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	29015000	37.70	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	12340000	40.80	No

8/2/12

Quantitative Peak Review KQ1207790-03



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	NA
Sample Matrix:	Soil	**Date Received:**	NA
Sample Name:	Duplicate Lab Control Sample	**Units:**	µg/Kg
Lab Code:	KQ1207790-04	**Basis:**	Dry

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**62.7**		2.5	2.5	1	7/ 9/12	7/31/12 08:28	162113	302794	
RDX	**69.2**		2.0	1.8	1	7/ 9/12	7/31/12 08:28	162113	302794	
1,3,5-Trinitrobenzene	**75.3**		2.8	2.8	1	7/ 9/12	7/31/12 08:28	162113	302794	
1,3-Dinitrobenzene	**114**		6.2	6.2	1	7/ 9/12	7/31/12 08:28	162113	302794	
Tetryl	**69.5**		2.0	1.8	1	7/ 9/12	7/31/12 08:28	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**77.5**		2.0	1.1	1	7/ 9/12	7/31/12 08:28	162113	302794	
4-Amino-2,6-dinitrotoluene	**80.9**		2.0	1.6	1	7/ 9/12	7/31/12 08:28	162113	302794	
2-Amino-4,6-dinitrotoluene	**74.5**		2.0	0.90	1	7/ 9/12	7/31/12 08:28	162113	302794	
2,4-Dinitrotoluene	**108**		12	12	1	7/ 9/12	7/31/12 08:28	162113	302794	
2,6-Dinitrotoluene	**128**		6.9	6.9	1	7/ 9/12	7/31/12 08:28	162113	302794	
3,5-Dinitroaniline	**90.0**		2.0	1.2	1	7/ 9/12	7/31/12 08:28	162113	302794	
PETN	**87.8**		2.0	2.0	1	7/ 9/12	7/31/12 08:28	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	72	70-130	7/31/12 08:28	
1,3-Dinitrobenzene-C13	109	70-130	7/31/12 08:28	

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6:23 pm, Aug 16, 2012

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

DLC

Sample Name	KQ1207790-04	**Injection Volume**	100
Acquisition Date	7/31/2012 8:28:01 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	39	**Weight to Volume**	0.00

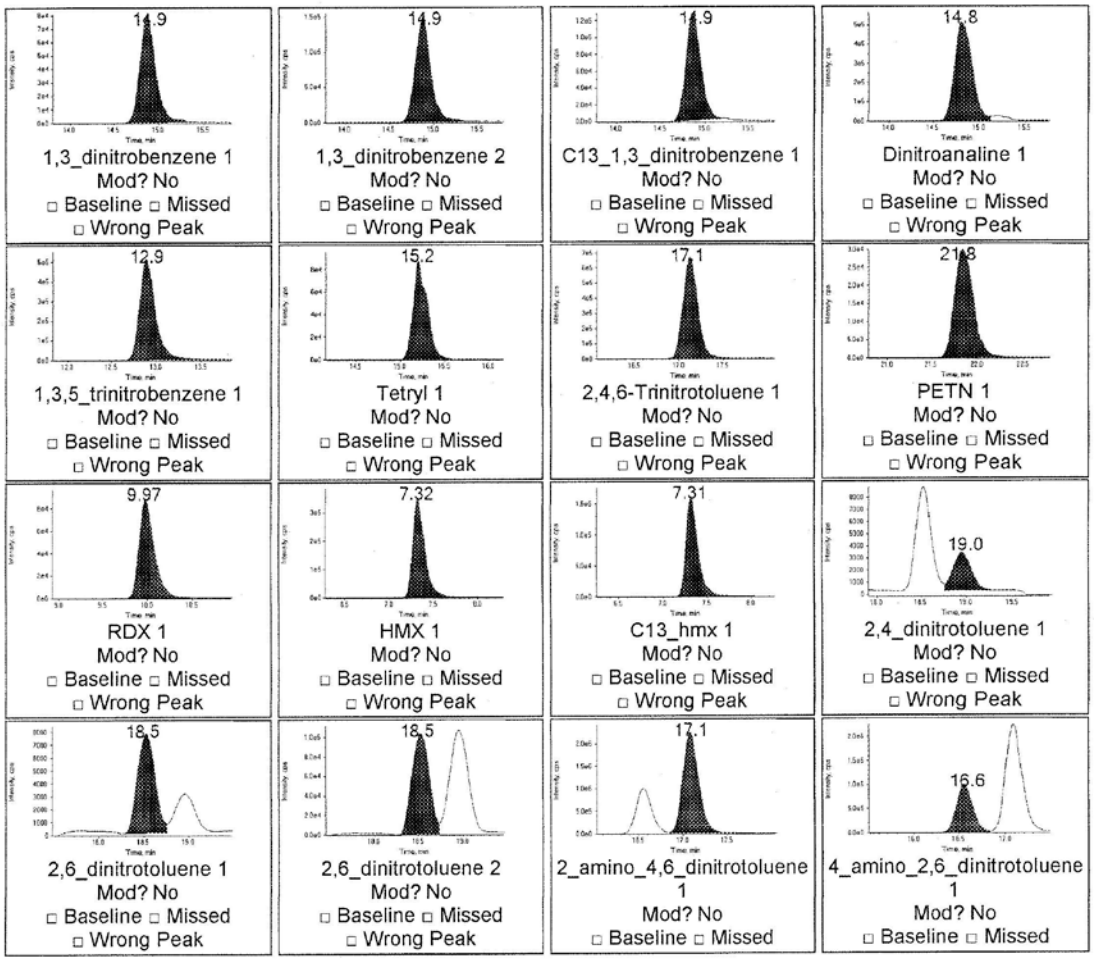
Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	988850	56.80	No
1,3_dinitrobenzene 2	14.90 (14.80)	1852000	56.00	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1511200	54.30	No
Dinitroanaline 1	14.80 (14.80)	6599900	45.00	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	6455100	37.70	No
Tetryl 1	15.20 (15.20)	984000	34.80	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	7936800	38.70	No
PETN 1	21.80 (21.80)	416050	43.90	No
RDX 1	9.97 (9.93)	1063500	34.60	No
HMX 1	7.32 (7.28)	3377300	31.30	No
C13_hmx 1	7.31 (7.25)	1565500	35.90	No
2,4_dinitrotoluene 1	19.00 (18.90)	43399	53.80	No
2,6_dinitrotoluene 1	18.50 (18.50)	107650	63.80	No
2,6_dinitrotoluene 2	18.50 (18.50)	1444100	62.60	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	28656000	37.20	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	12234000	40.40	No

8/2/12

8/10/12

Quantitative Peak Review KQ1207790-04



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Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Final	**Units:**	µg/Kg
Lab Code:	KQ1207790-01	**Basis:**	Dry
Run Type:	Matrix Spike	**Percent Solids:**	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**80.2**		2.5	2.5	1	7/ 9/12	7/31/12 07:08	162113	302794	
RDX	**71.1**		2.0	1.8	1	7/ 9/12	7/31/12 07:08	162113	302794	
1,3,5-Trinitrobenzene	**82.9**		2.8	2.8	1	7/ 9/12	7/31/12 07:08	162113	302794	
1,3-Dinitrobenzene	**98.4**		6.2	6.2	1	7/ 9/12	7/31/12 07:08	162113	302794	
Tetryl	**59.7**		2.0	1.8	1	7/ 9/12	7/31/12 07:08	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**75.8**		2.0	1.1	1	7/ 9/12	7/31/12 07:08	162113	302794	
4-Amino-2,6-dinitrotoluene	**90.1**		2.0	1.6	1	7/ 9/12	7/31/12 07:08	162113	302794	
2-Amino-4,6-dinitrotoluene	**79.8**		2.0	0.90	1	7/ 9/12	7/31/12 07:08	162113	302794	
2,4-Dinitrotoluene	**81.1**		12	12	1	7/ 9/12	7/31/12 07:08	162113	302794	
2,6-Dinitrotoluene	**72.7**		6.9	6.9	1	7/ 9/12	7/31/12 07:08	162113	302794	
3,5-Dinitroaniline	**80.9**		2.0	1.2	1	7/ 9/12	7/31/12 07:08	162113	302794	
PETN	**83.7**		2.0	2.0	1	7/ 9/12	7/31/12 07:08	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	82	70-130	7/31/12 07:08	
1,3-Dinitrobenzene-C13	94	70-130	7/31/12 07:08	

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6:23 pm, Aug 16, 2012

Columbia Analytical Services

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Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

MS

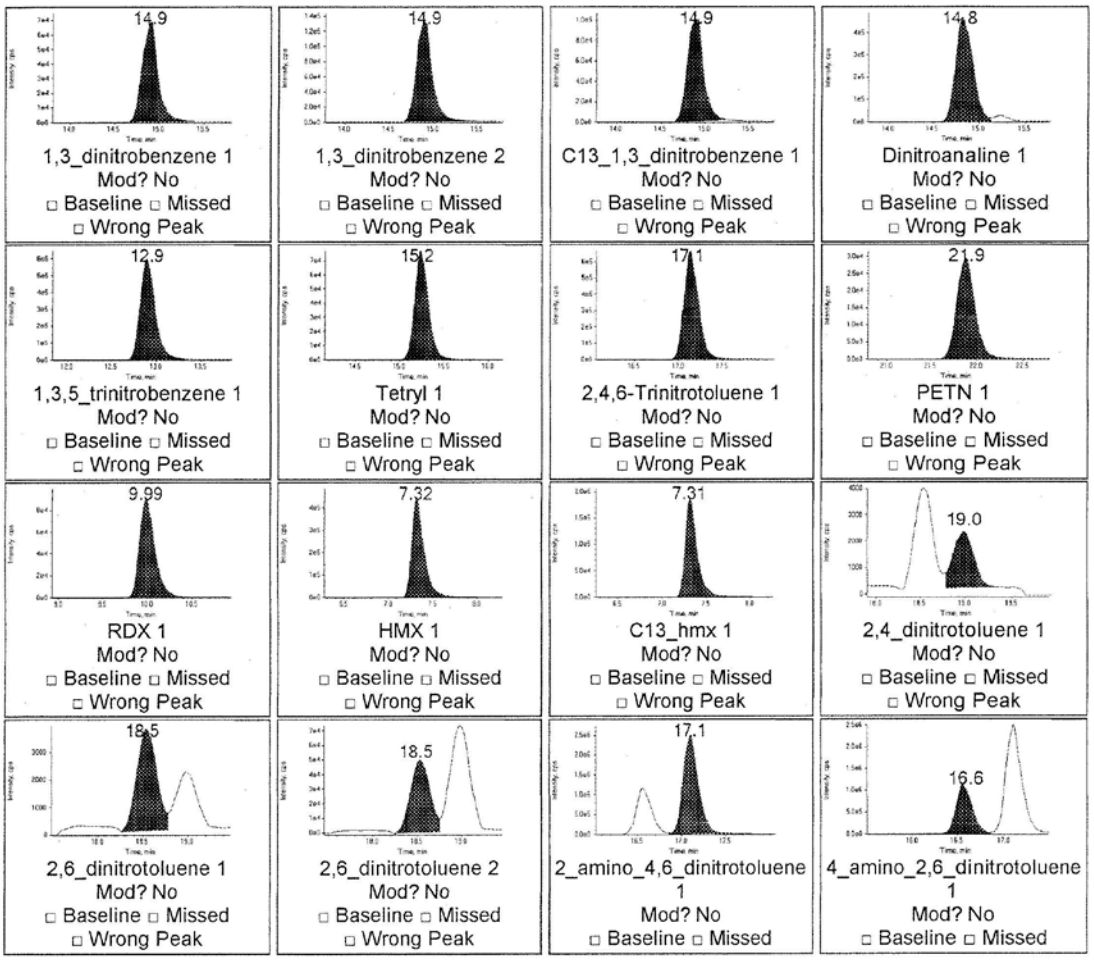
Sample Name	KQ1207790-01	**Injection Volume**	100
Acquisition Date	7/31/2012 7:08:01 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	36	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.90 (14.80)	854140	49.30	No
1,3_dinitrobenzene 2	14.90 (14.80)	1671700	50.70	No
C13_1,3_dinitrobenzene 1	14.90 (14.80)	1304200	47.20	No
Dinitroanaline 1	14.80 (14.80)	5936500	40.50	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	7115000	41.50	No
Tetryl 1	15.20 (15.20)	843600	29.90	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	7769700	37.90	No
PETN 1	21.90 (21.80)	396310	41.90	No
RDX 1	9.99 (9.93)	1094400	35.60	No
HMX 1	7.32 (7.28)	4340800	40.10	No
C13_hmx 1	7.31 (7.25)	1793500	40.90	No
2,4_dinitrotoluene 1	19.00 (18.90)	32658	40.60	No
2,6_dinitrotoluene 1	18.50 (18.50)	58713	36.40	No
2,6_dinitrotoluene 2	18.50 (18.50)	765070	34.60	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	30578000	40.00	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	13607000	45.10	No

8/2/12

Quantitative Peak Review KQ1207790-01



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
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Analytical Report

Client:	US Environmental Protection Agency	**Service Request:**	K1206333
Project:	Explosive Residue	**Date Collected:**	6/28/12
Sample Matrix:	Soil	**Date Received:**	6/30/12
Sample Name:	PD-Final	**Units:**	µg/Kg
Lab Code:	KQ1207790-02	**Basis:**	Dry
Run Type:	Duplicate Matrix Spike	**Percent Solids:**	99.5

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP
Prep Method: CAS SOP

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Analysis Lot	Note
HMX	**75.8**		2.5	2.5	1	7/ 9/12	7/31/12 07:34	162113	302794	
RDX	**67.2**		2.0	1.8	1	7/ 9/12	7/31/12 07:34	162113	302794	
1,3,5-Trinitrobenzene	**61.8**		2.8	2.8	1	7/ 9/12	7/31/12 07:34	162113	302794	
1,3-Dinitrobenzene	**86.8**		6.2	6.2	1	7/ 9/12	7/31/12 07:34	162113	302794	
Tetryl	**37.6**		2.0	1.8	1	7/ 9/12	7/31/12 07:34	162113	302794	
2,4,6-Trinitrotoluene (TNT)	**82.4**		2.0	1.1	1	7/ 9/12	7/31/12 07:34	162113	302794	
4-Amino-2,6-dinitrotoluene	**84.4**		2.0	1.6	1	7/ 9/12	7/31/12 07:34	162113	302794	
2-Amino-4,6-dinitrotoluene	**82.1**		2.0	0.90	1	7/ 9/12	7/31/12 07:34	162113	302794	
2,4-Dinitrotoluene	**88.8**		12	12	1	7/ 9/12	7/31/12 07:34	162113	302794	
2,6-Dinitrotoluene	**114**		6.9	6.9	1	7/ 9/12	7/31/12 07:34	162113	302794	
3,5-Dinitroaniline	**75.0**		2.0	1.2	1	7/ 9/12	7/31/12 07:34	162113	302794	
PETN	**79.2**		2.0	2.0	1	7/ 9/12	7/31/12 07:34	162113	302794	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Q
C13-HMX	77	70-130	7/31/12 07:34	
1,3-Dinitrobenzene-C13	87	70-130	7/31/12 07:34	

REVISED
6:23 pm, Aug 16, 2012

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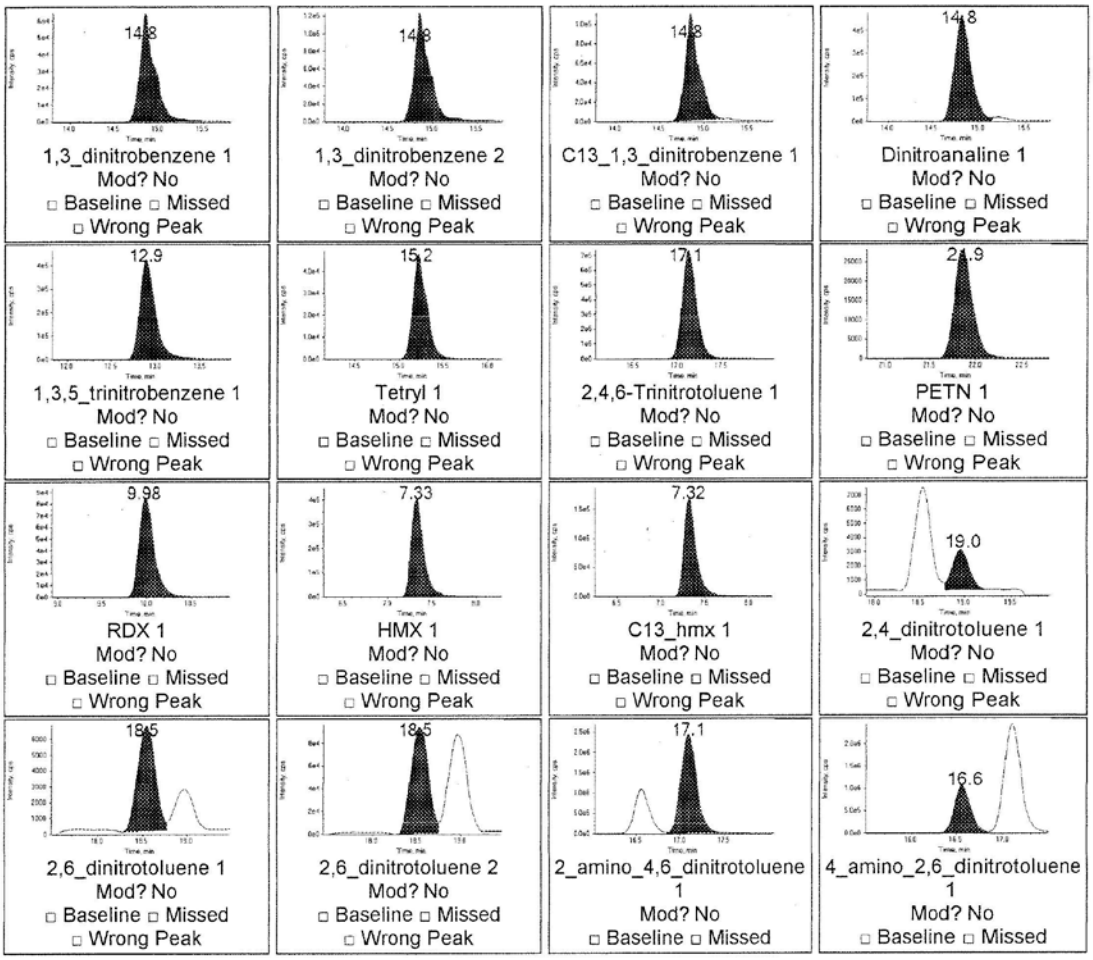
Project	Ewan's Projects\Explosives
Data File	073012\Spl.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	KQ1207790-02	**Injection Volume**	100
Acquisition Date	7/31/2012 7:34:41 AM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	37	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	751560	43.50	No
1,3_dinitrobenzene 2	14.80 (14.80)	1444800	44.00	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1204200	43.70	No
Dinitroanaline 1	14.80 (14.80)	5515100	37.60	No
1,3,5_trinitrobenzene 1	12.90 (12.80)	5307400	31.00	No
Tetryl 1	15.20 (15.20)	529650	18.80	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	8454600	41.30	No
PETN 1	21.90 (21.80)	375060	39.70	No
RDX 1	9.98 (9.93)	1035200	33.70	No
HMX 1	7.33 (7.28)	4104100	38.00	No
C13_hmx 1	7.32 (7.25)	1678300	38.40	No
2,4_dinitrotoluene 1	19.00 (18.90)	35820	44.50	No
2,6_dinitrotoluene 1	18.50 (18.50)	94974	56.90	No
2,6_dinitrotoluene 2	18.50 (18.50)	1332000	58.20	No
2_amino_4,6_dinitrotoluene 1	17.10 (17.00)	31424000	41.20	No
4_amino_2,6_dinitrotoluene 1	16.60 (16.50)	12773000	42.30	No

Quantitative Peak Review KQ1207790-02



☐ Before ☐ After

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Standards Data

COLUMBIA ANALYTICAL SERVICES, INC.
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QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date	#	File Location	Acquisition Date
02	073012\Calib.wiff	7/30/12 14:41	03	073012\Calib.wiff	7/30/12 15:08
04	073012\Calib.wiff	7/30/12 15:35	05	073012\Calib.wiff	7/30/12 16:01
06	073012\Calib.wiff	7/30/12 16:28	07	073012\Calib.wiff	7/30/12 16:54
08	073012\Calib.wiff	7/30/12 17:21			

Analyte

HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	9.404E4	03	2.00	9.609E4	04	5.00	9.957E4	05	10.0	1.112E5
06	50.0	1.078E5	07	100.	1.100E5	08	200.	1.127E5			

RDX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.985E4	03	2.00	2.908E4	04	5.00	3.004E4	05	10.0	3.156E4
06	50.0	3.169E4	07	100.	3.084E4	08	200.	3.290E4			

1,3,5-Trinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.481E5	03	2.00	1.595E5	04	5.00	1.760E5	05	10.0	1.810E5
06	50.0	1.817E5	07	100.	1.611E5	08	200.	1.714E5			

1,3-Dinitrobenzene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.706E4	03	2.00	1.905E4	04	5.00	1.746E4	05	10.0	1.751E4
06	50.0	1.708E4	07	100.	1.799E4	08	200.	1.907E4			

Tetryl

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.763E4	03	2.00	2.899E4	04	5.00	2.936E4	05	10.0	3.046E4
06	50.0	2.735E4	07	100.	2.946E4	08	200.	3.037E4			

2,4,6-Trinitrotoluene (TNT)

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.992E5	03	2.00	2.092E5	04	5.00	2.237E5	05	10.0	2.148E5
06	50.0	2.052E5	07	100.	2.040E5	08	200.	2.117E5			

4-Amino-2,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.915E5	03	2.00	2.980E5	04	5.00	3.193E5	05	10.0	3.262E5
06	50.0	3.068E5	07	100.	2.846E5	08	200.	2.783E5			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

Analyte

2-Amino-4,6-dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	7.461E5	03	2.00	7.928E5	04	5.00	8.506E5	05	10.0	8.428E5
06	50.0	7.692E5	07	100.	6.518E5	08	200.	5.264E5			

2,4-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	605.0	03	2.00	658.5	04	5.00	739.5	05	10.0	723.6
06	50.0	805.2	07	100.	751.6	08	200.	841.6			

2,6-Dinitrotoluene

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1,363	03	2.00	1,273	04	5.00	1,660	05	10.0	1,684
06	50.0	1,790	07	100.	1,647	08	200.	2,073			

3,5-Dinitroaniline

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	1.309E5	03	2.00	1.400E5	04	5.00	1.435E5	05	10.0	1.510E5
06	50.0	1.481E5	07	100.	1.438E5	08	200.	1.442E5			

PETN

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	8,939	03	2.00	8,985	04	5.00	9,398	05	10.0	9,423
06	50.0	9,636	07	100.	9,745	08	200.	1.061E4			

C13-HMX

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	3.753E4	03	2.00	3.852E4	04	5.00	3.957E4	05	10.0	4.467E4
06	50.0	4.414E4	07	100.	4.577E4	08	200.	4.968E4			

1,3-Dinitrobenzene-C13

#	Amount	RF	#	Amount	RF	#	Amount	RF	#	Amount	RF
02	1.00	2.720E4	03	2.00	2.944E4	04	5.00	2.628E4	05	10.0	2.853E4
06	50.0	2.809E4	07	100.	2.835E4	08	200.	3.124E4			

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

		Calibration Evaluation					RRF Evaluation		
Analyte Name	**Compound Type**	**Fit Type**	**Eval.**	**Eval. Result**	**Q**	**Control Criteria**	**Average RRF**	**Q**	**Minimum RRF**
HMX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
RDX	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
1,3,5-Trinitrobenzene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
1,3-Dinitrobenzene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
Tetryl	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2,4,6-Trinitrotoluene (TNT)	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
4-Amino-2,6-dinitrotoluene	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
2-Amino-4,6-dinitrotoluene	TRG	Quadratic	COD	0.999		≥ 0.990	NA		
2,4-Dinitrotoluene	TRG	Linear	R2	0.997		≥ 0.990	NA		
2,6-Dinitrotoluene	TRG	Quadratic	COD	0.998		≥ 0.990	NA		
3,5-Dinitroaniline	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
PETN	TRG	Quadratic	COD	1.000		≥ 0.990	NA		
C13-HMX	SURR	Quadratic	COD	1.000		≥ 0.990	NA		
1,3-Dinitrobenzene-C13	SURR	Quadratic	COD	1.000		≥ 0.990	NA		

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Calibration Date: 7/30/12

Initial Calibration Verfication Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Calibration ID: KC1200067
Instrument ID: K-LCMS-02

Signal ID: 1

#	File Location	Acquisition Date
40	073012\Calib.wiff	7/30/12 18:41

Analyte Name	Expected	Result	Average RF	SSV RF	%D	Criteria	Curve Fit
HMX	100.	112.780	1.045E5	1.244E5	12.78	±30	Quadratic
RDX	100.	109.539	3.085E4	3.469E4	9.54	±30	Quadratic
1,3,5-Trinitrobenzene	100.	113.984	1.684E5	1.945E5	13.98	±30	Quadratic
1,3-Dinitrobenzene	100.	125.197	1.789E4	2.279E4	25.20	±30	Quadratic
Tetryl	100.	121.625	2.909E4	3.573E4	21.63	±30	Quadratic
2,4,6-Trinitrotoluene (TNT)	100.	122.828	2.097E5	2.554E5	22.83	±30	Quadratic
4-Amino-2,6-dinitrotoluene	100.	114.681	3.007E5	3.331E5	14.68	±30	Quadratic
2-Amino-4,6-dinitrotoluene	100.	118.245	7.400E5	7.645E5	18.24	±30	Quadratic
2,4-Dinitrotoluene	100.	112.377	732.1	909.2	12.38	±30	Linear
2,6-Dinitrotoluene	100.	117.310	1,641	2,146	17.31	±30	Quadratic
3,5-Dinitroaniline	100.	112.234	1.431E5	1.633E5	12.23	±30	Quadratic
PETN	100.	111.426	9,534	1.109E4	11.43	±30	Quadratic
C13-HMX	100.	105.792	4.284E4	4.890E4	5.79	±30	Quadratic
1,3-Dinitrobenzene-C13	100.	116.671	2.845E4	3.410E4	16.67	±30	Quadratic

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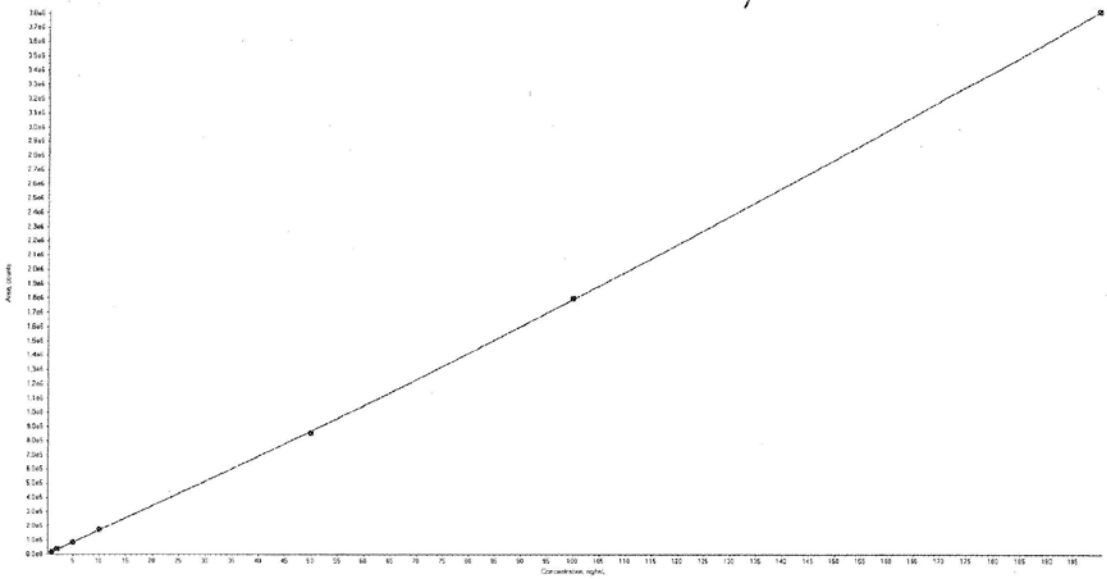
Analyte Name: 1,3_dinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 11.7 x^2 + 1.67e+004 x + 2.1e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.89	89	NaN	NaN
2	1	2.15	107	NaN	NaN
5	1	5.08	102	NaN	NaN
10	1	10.27	103	NaN	NaN
50	1	49.24	98	NaN	NaN
100	1	100.40	100	NaN	NaN
200	1	199.97	100	NaN	NaN



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8/10/12

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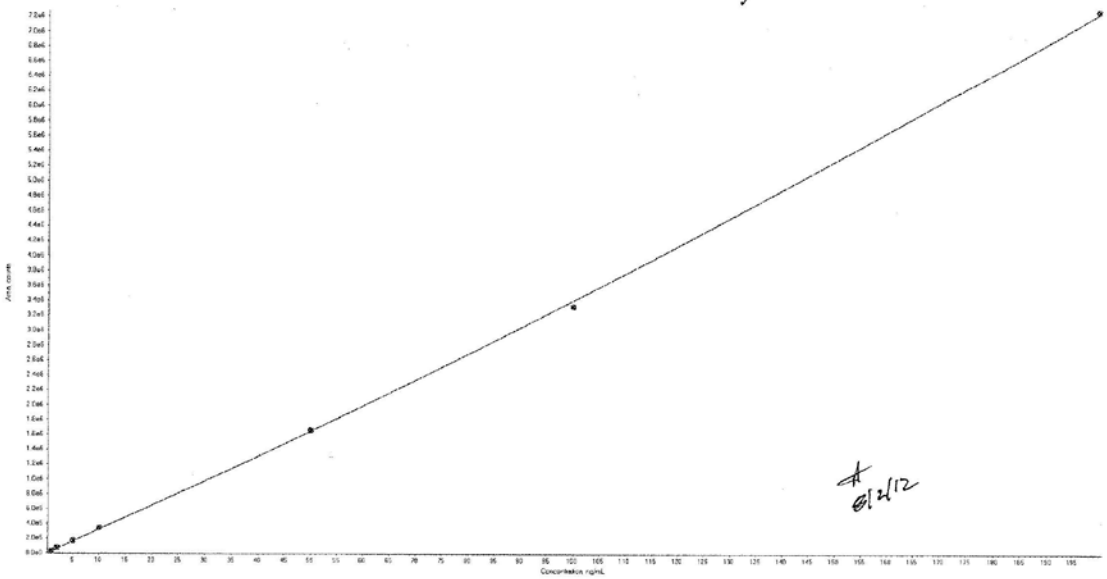
Analyte Name: 1,3_dinitrobenzene 2
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 22.1 x^2 + 3.18e+004 x + 3.12e+003 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.79	79	NaN	NaN
2	1	2.22	111	NaN	NaN
5	1	5.22	104	NaN	NaN
10	1	10.62	106	NaN	NaN
50	1	50.47	101	NaN	NaN
100	1	97.88	98	NaN	NaN
200	1	200.81	100	NaN	NaN



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Columbia Analytical Services

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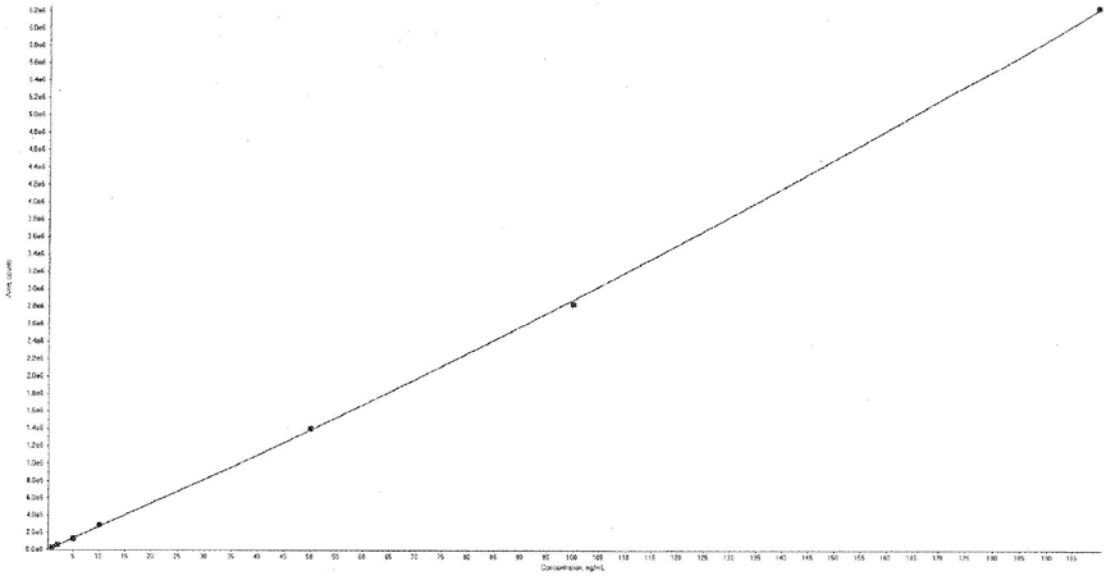
Analyte Name: C13_1,3_dinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 23.1 x^2 + 2.65e+004 x + 2.77e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.92	92	NaN	NaN
2	1	2.11	106	NaN	NaN
5	1	4.83	97	NaN	NaN
10	1	10.56	106	NaN	NaN
50	1	50.65	101	NaN	NaN
100	1	98.39	98	NaN	NaN
200	1	200.55	100	NaN	NaN



8/2/12
8/10/12

Columbia Analytical Services

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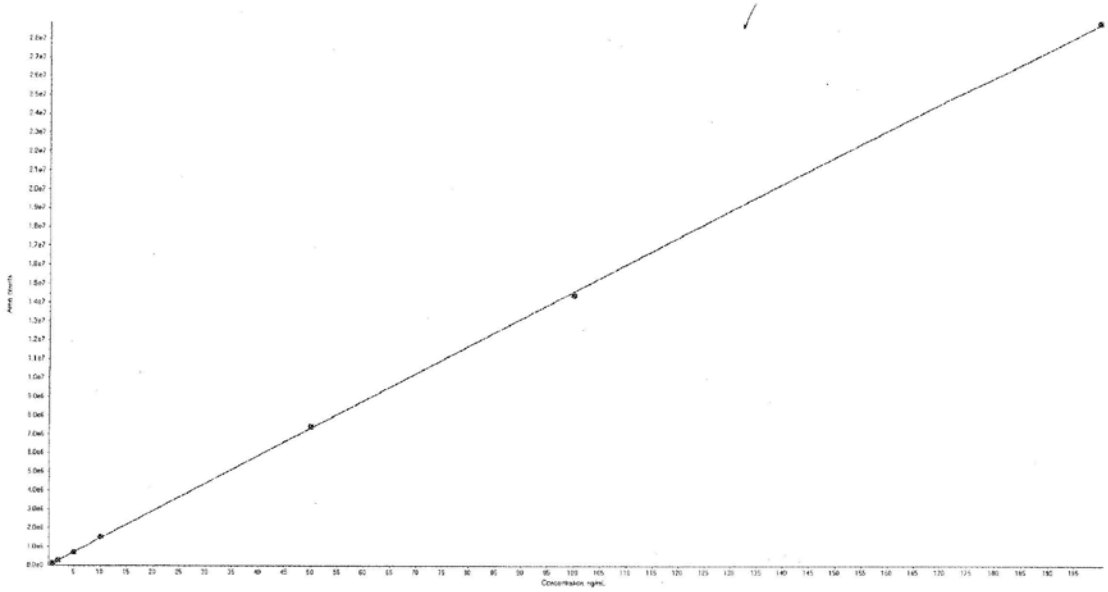
Analyte Name: Dinitroanaline 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -19.3 x^2 + 1.48e+005 x + -1.41e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.98	98	NaN	NaN
2	1	1.99	100	NaN	NaN
5	1	4.95	99	NaN	NaN
10	1	10.33	103	NaN	NaN
50	1	50.54	101	NaN	NaN
100	1	98.70	99	NaN	NaN
200	1	200.51	100	NaN	NaN



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8/2/12

Columbia Analytical Services

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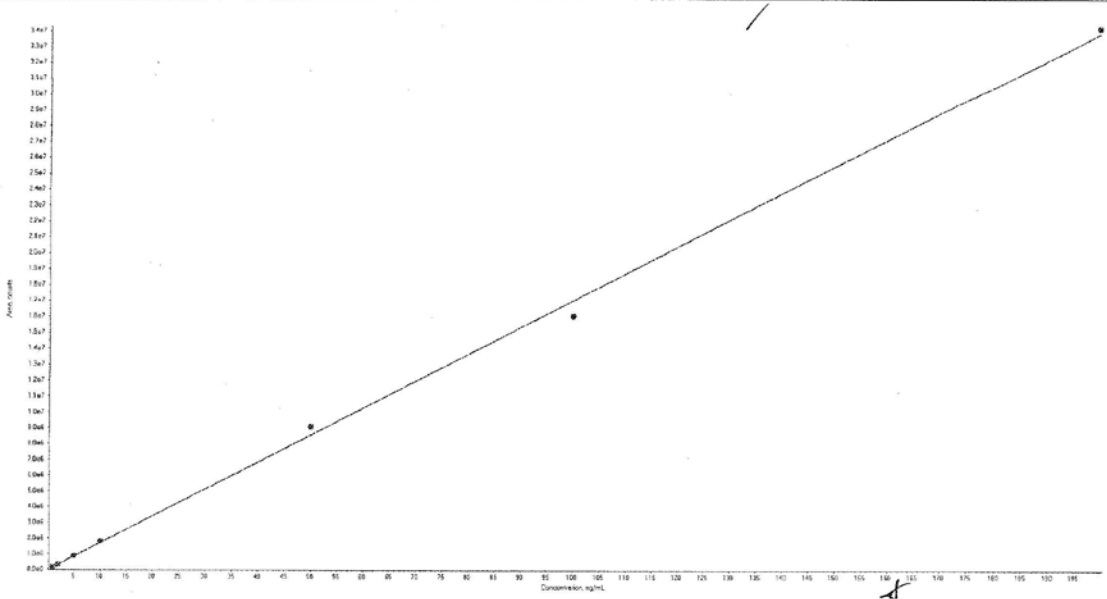
Printed: 8/2/2012 7:45 AM

Analyte Name: 1,3,5_trinitrobenzene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -12.6 x^2 + 1.72e+005 x + -1.21e+004 (r = 0.9991)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.93	93	NaN	NaN
2	1	1.92	96	NaN	NaN
5	1	5.18	104	NaN	NaN
10	1	10.59	106	NaN	NaN
50	1	53.02	106	NaN	NaN
100	1	94.24	94	NaN	NaN
200	1	202.12	101	NaN	NaN



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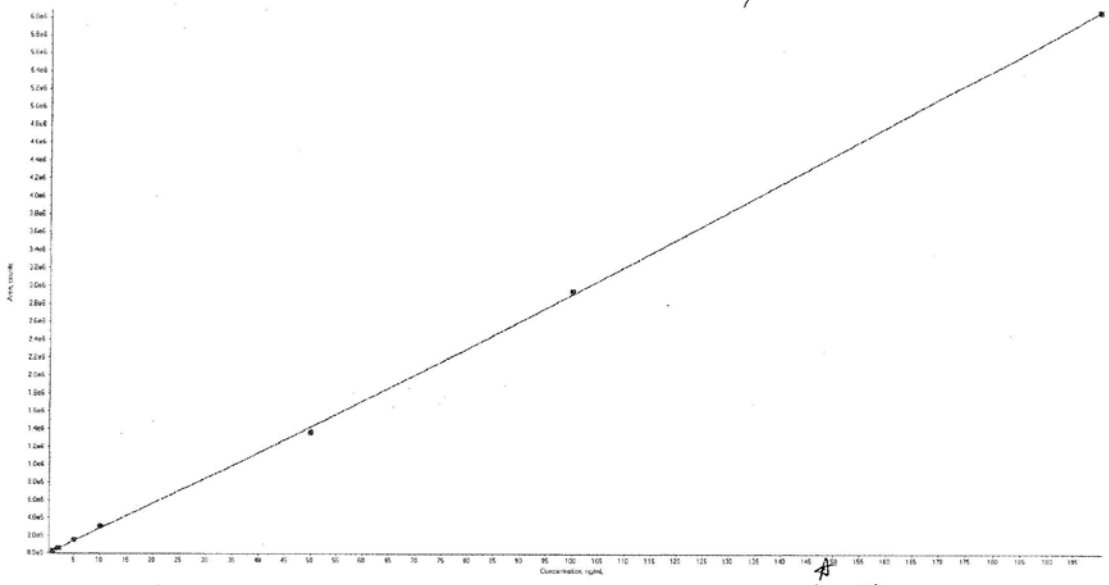
Analyte Name: Tetryl 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 13 x^2 + 2.78e+004 x + 2.39e+003 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.91	91	NaN	NaN
2	1	2.00	100	NaN	NaN
5	1	5.19	104	NaN	NaN
10	1	10.83	108	NaN	NaN
50	1	48.06	96	NaN	NaN
100	1	101.17	101	NaN	NaN
200	1	199.85	100	NaN	NaN



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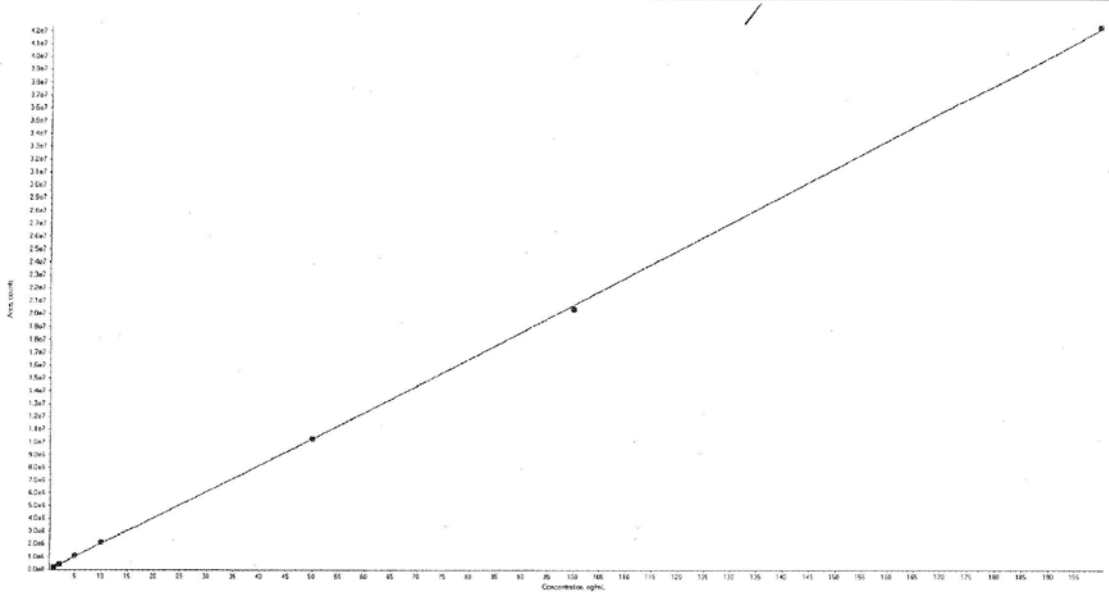
Analyte Name: 2,4,6-Trinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 40.3 x^2 + 2.03e+005 x + 1.81e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.89	89	NaN	NaN
2	1	1.97	99	NaN	NaN
5	1	5.42	108	NaN	NaN
10	1	10.48	105	NaN	NaN
50	1	50.01	100	NaN	NaN
100	1	98.58	99	NaN	NaN
200	1	200.65	100	NaN	NaN



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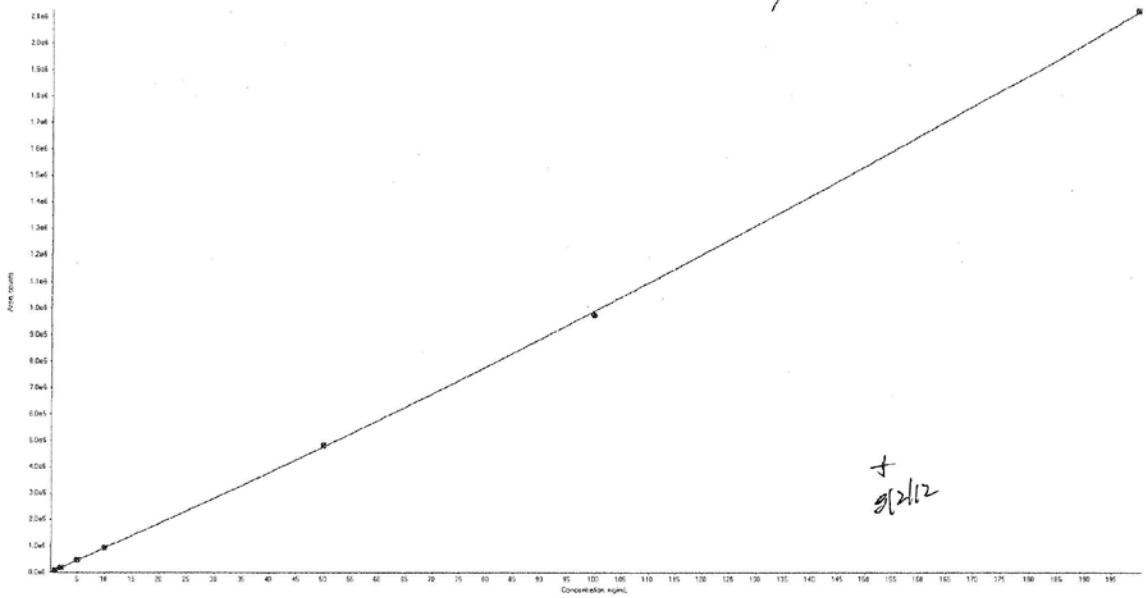
Analyte Name: PETN 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 7.1 x^2 + 9.17e+003 x + -20.1 (r = 1.0000)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.98	98	NaN	NaN
2	1	1.96	98	NaN	NaN
5	1	5.11	102	NaN	NaN
10	1	10.20	102	NaN	NaN
50	1	50.59	101	NaN	NaN
100	1	98.76	99	NaN	NaN
200	1	200.41	100	NaN	NaN



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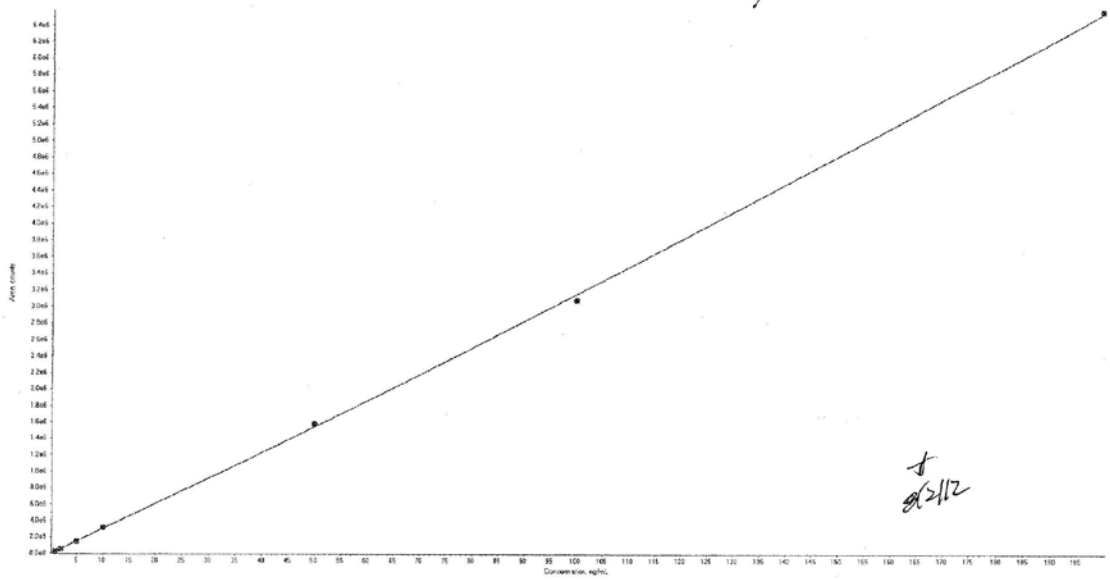
Analyte Name: RDX 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 12.1 x^2 + 3.03e+004 x + -500 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.00	100	NaN	NaN
2	1	1.93	97	NaN	NaN
5	1	4.96	99	NaN	NaN
10	1	10.37	104	NaN	NaN
50	1	51.19	102	NaN	NaN
100	1	97.82	98	NaN	NaN
200	1	200.73	100	NaN	NaN



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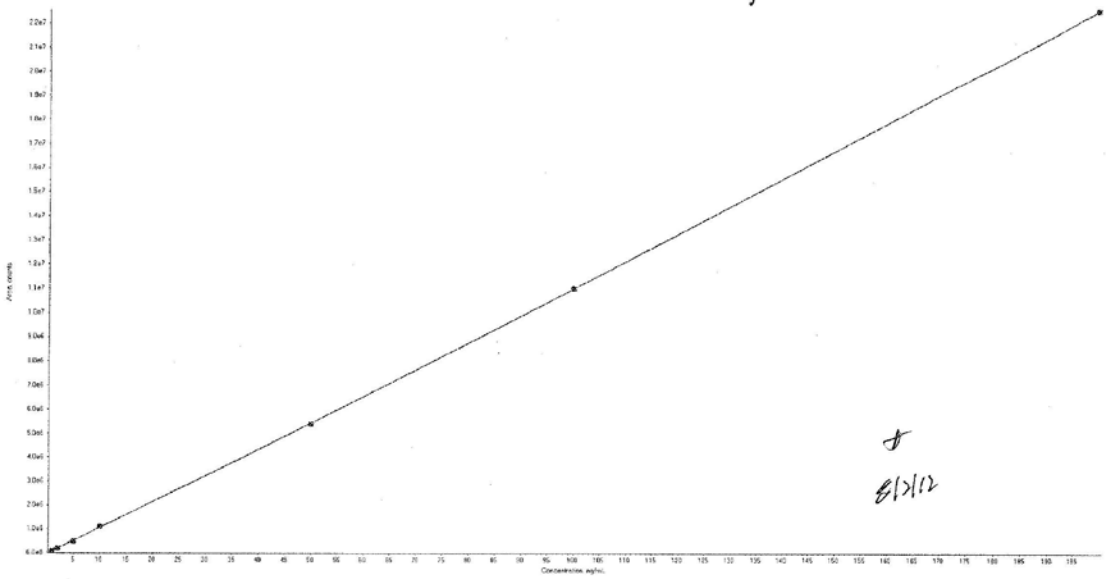
Analyte Name: HMX 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 26.6 x^2 + 1.07e+005 x + -1.67e+004 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.03	103	NaN	NaN
2	1	1.94	97	NaN	NaN
5	1	4.78	96	NaN	NaN
10	1	10.48	105	NaN	NaN
50	1	49.71	99	NaN	NaN
100	1	100.02	100	NaN	NaN
200	1	200.04	100	NaN	NaN



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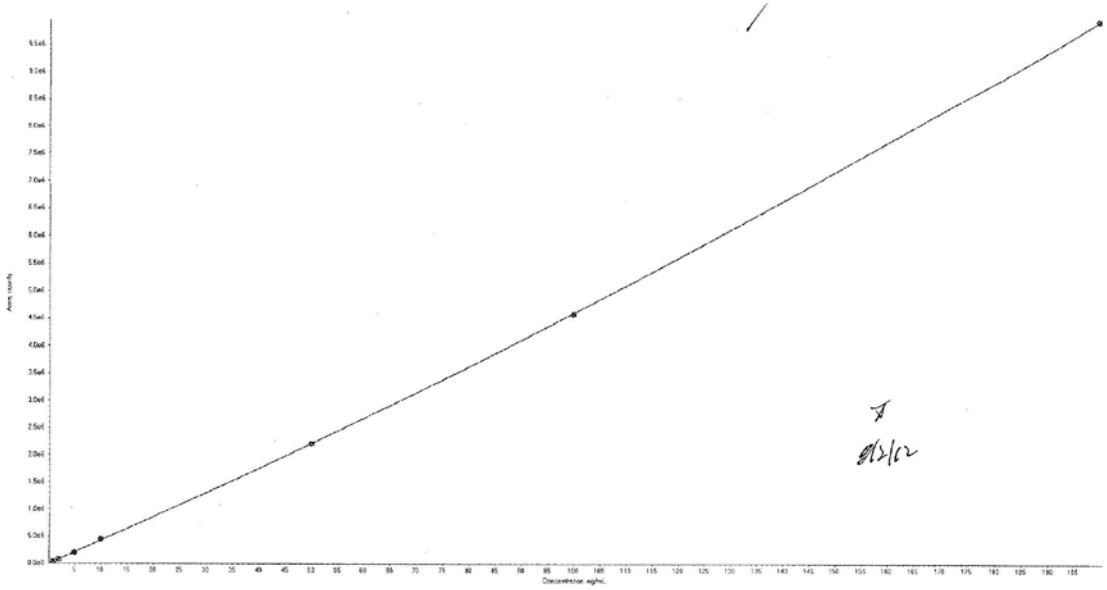
Analyte Name: C13_hmx 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 35.9 x^2 + 4.25e+004 x + -5.8e+003 (r = 0.9999)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.02	102	NaN	NaN
2	1	1.95	97	NaN	NaN
5	1	4.78	96	NaN	NaN
10	1	10.56	106	NaN	NaN
50	1	49.99	100	NaN	NaN
100	1	99.53	100	NaN	NaN
200	1	200.19	100	NaN	NaN



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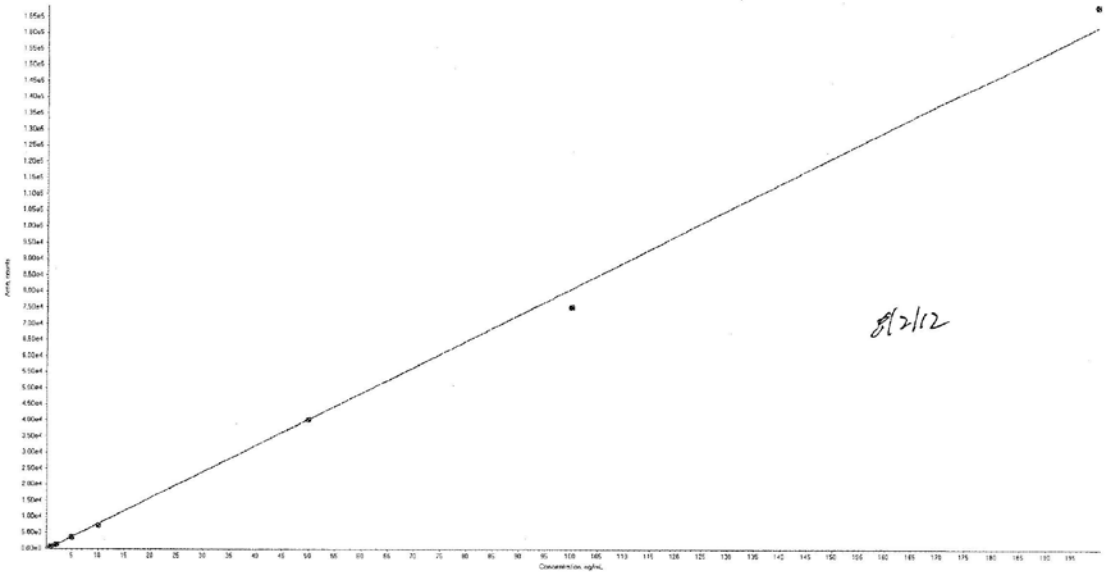
Analyte Name: 2,4_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 812 x + -304 (r = 0.9987)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	1.12	112	NaN	NaN
2	1	2.00	100	NaN	NaN
5	1	4.93	99	NaN	NaN
10	1	9.29	93	NaN	NaN
50	1	49.97	100	NaN	NaN
100	1	92.97	93	NaN	NaN
200	1	207.73	104	NaN	NaN



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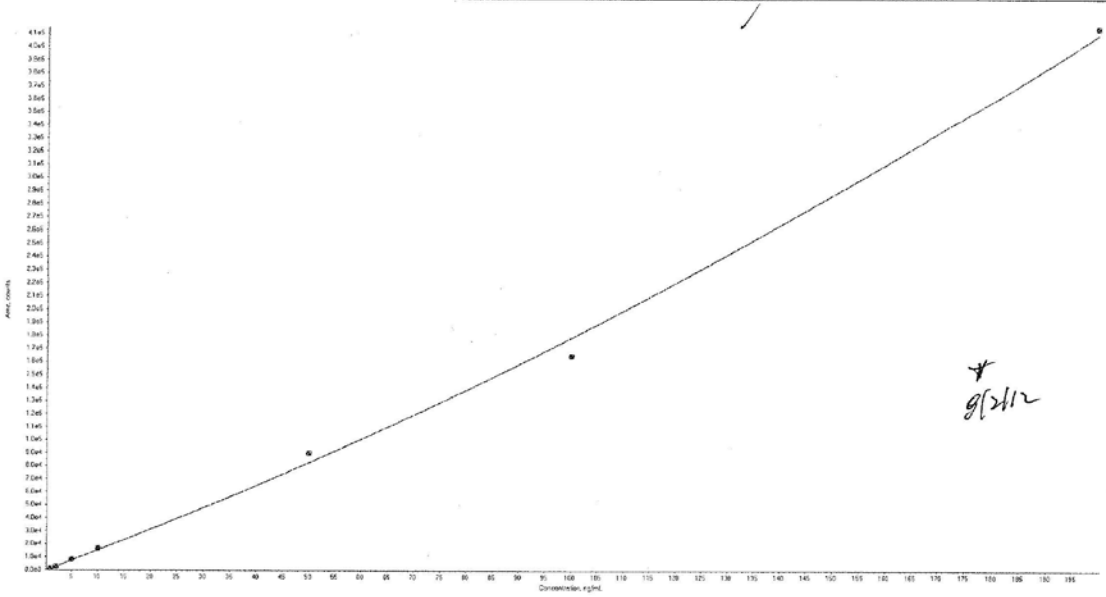
Analyte Name: 2,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 2.65 x^2 + 1.52e+003 x + -64.2 (r = 0.9987)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.71	86	NaN	NaN
5	1	5.46	109	NaN	NaN
10	1	10.92	109	NaN	NaN
50	1	53.91	108	NaN	NaN
100	1	93.31	93	NaN	NaN
200	1	201.92	101	NaN	NaN



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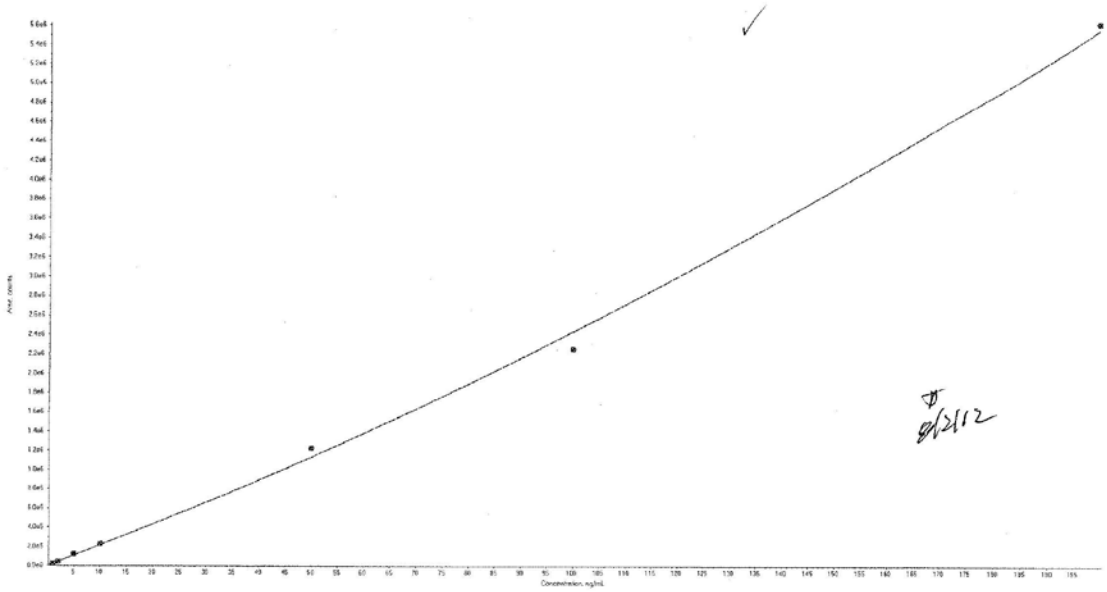
Analyte Name: 2,6_dinitrotoluene 2
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = 34.8 x^2 + 2.08e+004 x + 3.4e+003 (r = 0.9988)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.83	83	NaN	NaN
2	1	1.91	96	NaN	NaN
5	1	5.61	112	NaN	NaN
10	1	10.66	107	NaN	NaN
50	1	53.74	107	NaN	NaN
100	1	93.51	94	NaN	NaN
200	1	201.89	101	NaN	NaN



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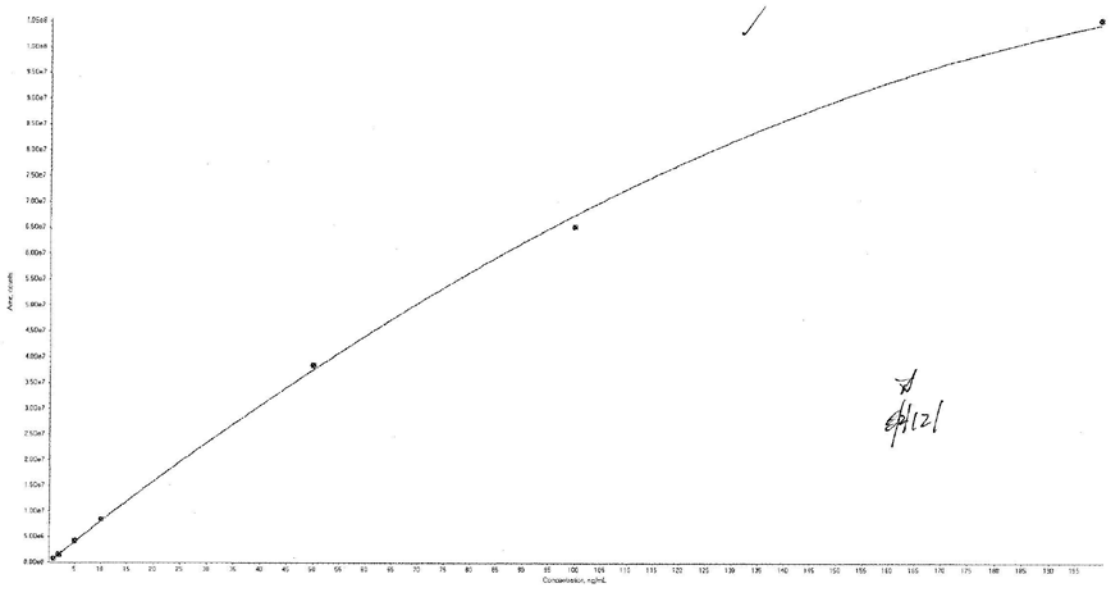
Analyte Name: 2_amino_4,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -1.52e+003 x^2 + 8.27e+005 x + -2.61e+004 (r = 0.9996)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.96	98	NaN	NaN
5	1	5.23	105	NaN	NaN
10	1	10.42	104	NaN	NaN
50	1	51.41	103	NaN	NaN
100	1	95.75	96	NaN	NaN
200	1	204.09	102	NaN	NaN



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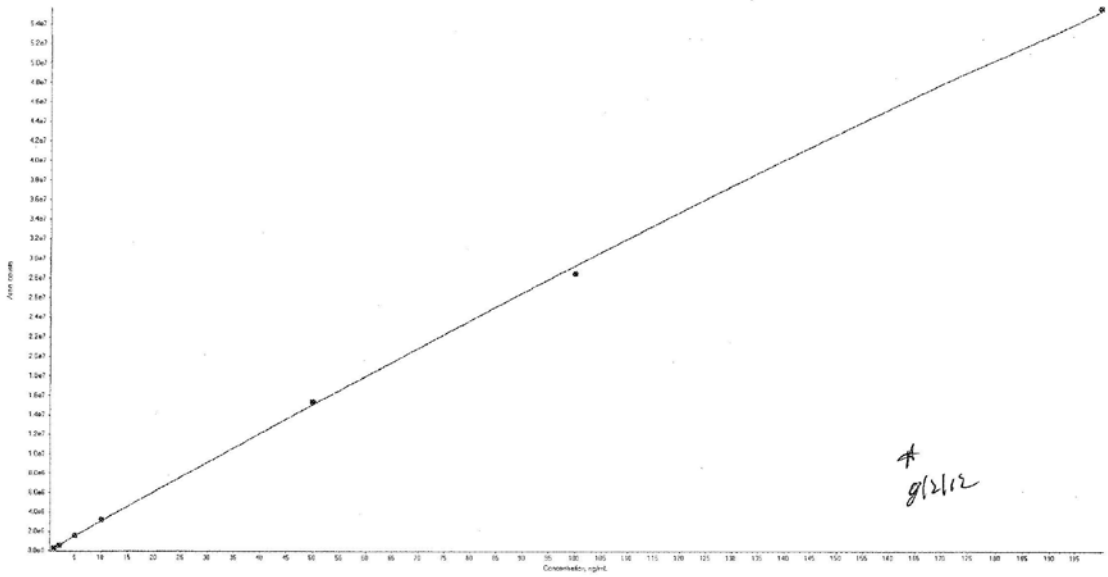
Analyte Name: 4_amino_2,6_dinitrotoluene 1
Internal Standard:

Data File	073012\Calib.wiff	**Result Table**	073012.rdb
Acquisition Date	7/30/2012 2:15:03 PM	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02
Project	Ewan's Projects\Explosives		

Regression Equation: y = -162 x^2 + 3.09e+005 x + 606 (r = 0.9998)

Exp Conc (ng/mL)	# of Values	Mean Calc Conc (ng/mL)	% Accuracy	STD	%CV
1	1	0.94	94	NaN	NaN
2	1	1.93	96	NaN	NaN
5	1	5.18	104	NaN	NaN
10	1	10.61	106	NaN	NaN
50	1	51.01	102	NaN	NaN
100	1	97.02	97	NaN	NaN
200	1	201.35	101	NaN	NaN



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Project	Ewan's Projects\Explosives
Data File	073012\Calib.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	IB	**Injection Volume**	100
Acquisition Date	7/30/2012 2:15:03 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	1	**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0 ✓	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0 ✓	N/A	No
C13_1,3_dinitrobenzene 1	0.00 (14.80)	0 ✓	N/A	No
Dinitroanaline 1	14.80 (14.80)	18853 <½	0.22	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	11833 <½	0.14	No
Tetryl 1	15.10 (15.20)	1269 <½	N/A	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	13477 <½	N/A	No
PETN 1	21.80 (21.80)	860 <½	0.10	No
RDX 1	9.90 (9.93)	3271 <½	0.12	No
HMX 1	7.29 (7.28)	10511 <½	0.25	No
C13_hmx 1	0.00 (7.25)	0	N/A	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	75594 <½	0.12	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	26674 <½	0.08	No

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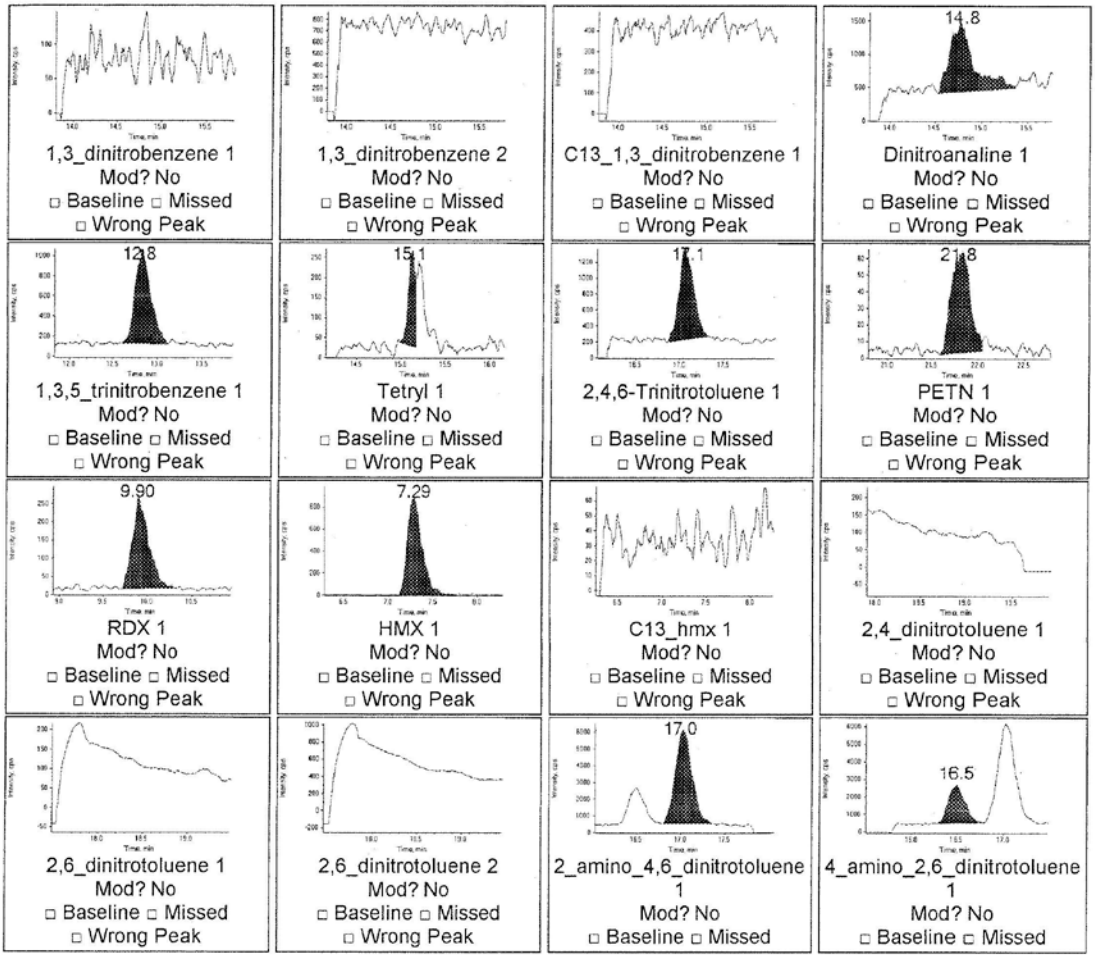
Quantitative Peak Review IB



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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 1ppb	**Injection Vial**	2
Acquisition Date	7/30/2012 2:41:42 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23B	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	17061	1.00	0.89	89	No
1,3_dinitrobenzene 2	14.80 (14.80)	28345	1.00	0.79	79	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	27198	1.00	0.92	92	No
Dinitroanaline 1	14.80 (14.80)	130880	1.00	0.98	98	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	148070	1.00	0.93	93	No
Tetryl 1	15.20 (15.20)	27634	1.00	0.91	91	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	199170	1.00	0.89	89	No
PETN 1	21.80 (21.80)	8939	1.00	0.98	98	No
RDX 1	9.91 (9.93)	29847	1.00	1.00	100	No
HMX 1	7.28 (7.28)	94041	1.00	1.03	103	No
C13_hmx 1	7.28 (7.25)	37528	1.00	1.02	102	No
2,4_dinitrotoluene 1	18.90 (18.90)	605	1.00	1.12	112	No
2,6_dinitrotoluene 1	18.50 (18.50)	1363	1.00	0.94	94	No
2,6_dinitrotoluene 2	18.50 (18.50)	20812	1.00	0.84	84	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	746120	1.00	0.94	94	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	291540	1.00	0.94	94	No

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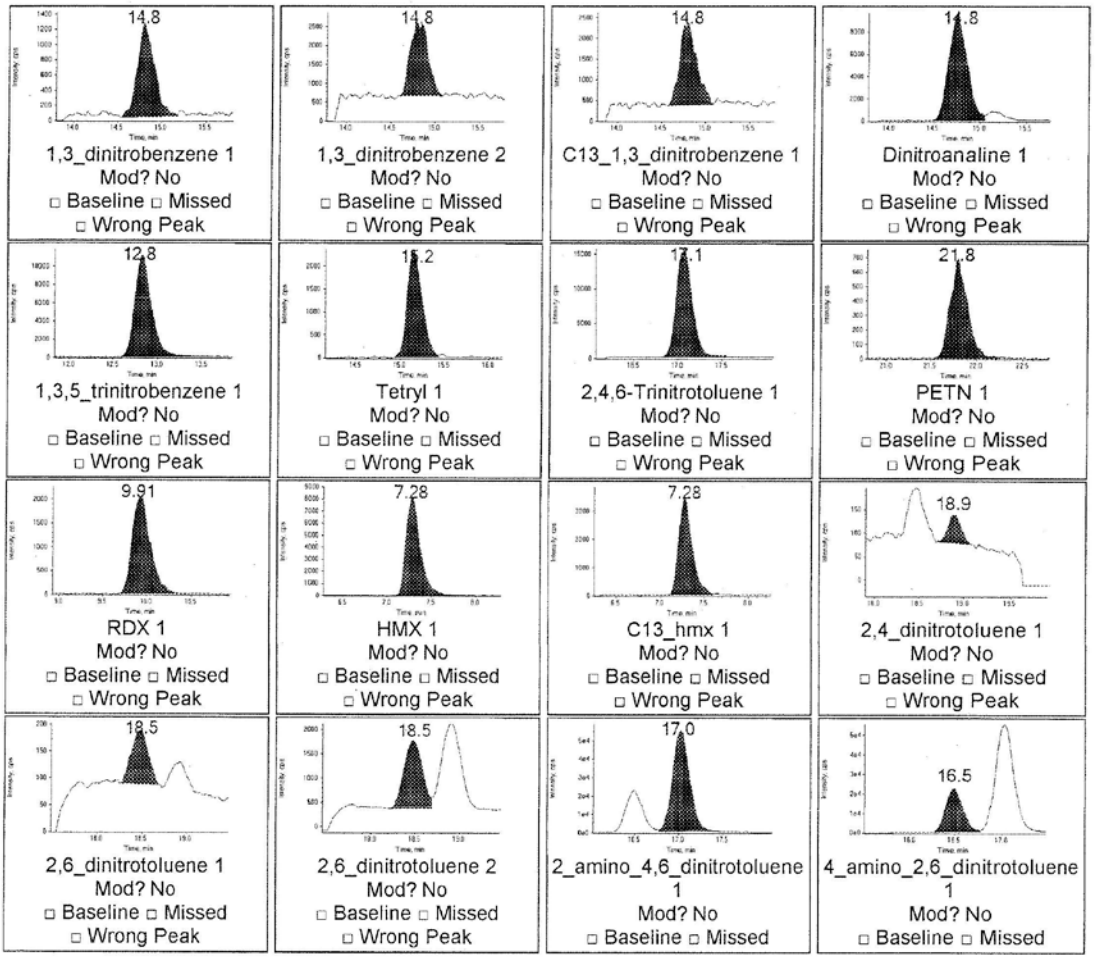
Quantitative Peak Review — Explosives 1ppb



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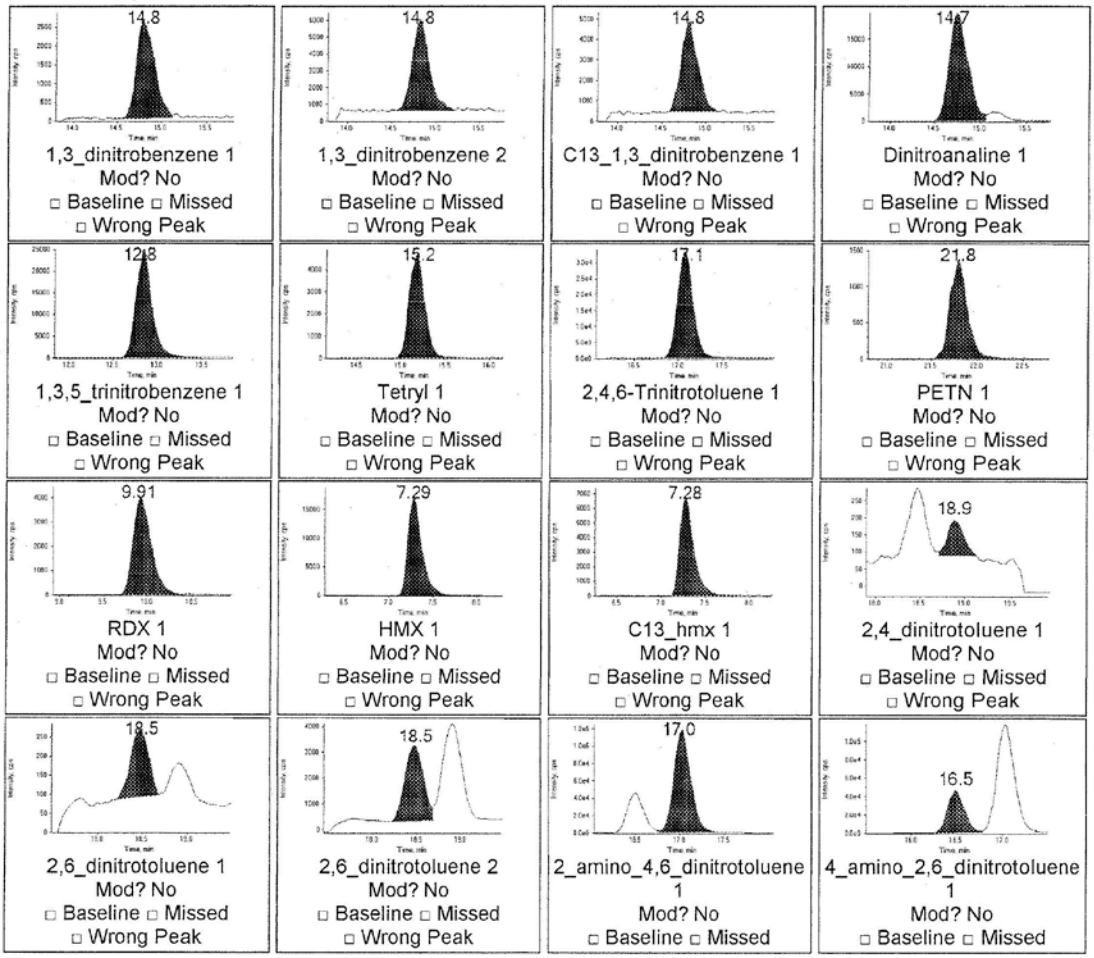
Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 2ppb	**Injection Vial**	3
Acquisition Date	7/30/2012 3:08:21 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23C	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	38099	2.00	2.15	107	No
1,3_dinitrobenzene 2	14.80 (14.80)	73738	2.00	2.22	111	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	58884	2.00	2.11	106	No
Dinitroanaline 1	14.70 (14.80)	280070	2.00	1.99	100	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	318930	2.00	1.92	96	No
Tetryl 1	15.20 (15.20)	57987	2.00	2.00	100	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	418380	2.00	1.97	99	No
PETN 1	21.80 (21.80)	17970	2.00	1.96	98	No
RDX 1	9.91 (9.93)	58166	2.00	1.93	97	No
HMX 1	7.29 (7.28)	192190	2.00	1.94	97	No
C13_hmx 1	7.28 (7.25)	77038	2.00	1.95	97	No
2,4_dinitrotoluene 1	18.90 (18.90)	1317	2.00	2.00	100	No
2,6_dinitrotoluene 1	18.50 (18.50)	2545	2.00	1.71	86	No
2,6_dinitrotoluene 2	18.50 (18.50)	43334	2.00	1.91	96	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	1585600	2.00	1.96	98	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	595980	2.00	1.93	96	No

Quantitative Peak Review — Explosives 2ppb



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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 5ppb	**Injection Vial**	4
Acquisition Date	7/30/2012 3:35:00 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23D	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

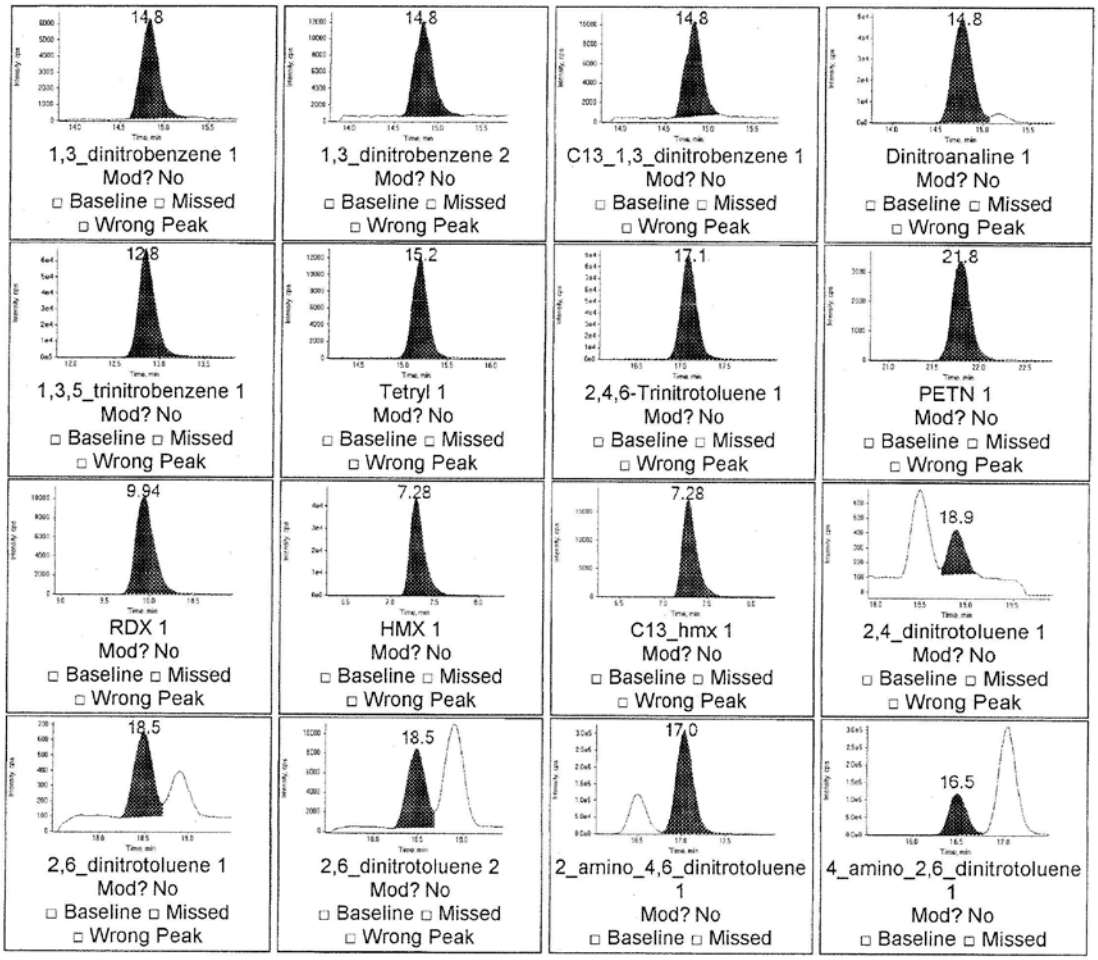
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	87314	5.00	5.08	102	No
1,3_dinitrobenzene 2	14.80 (14.80)	169720	5.00	5.22	104	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	131410	5.00	4.83	97	No
Dinitroanaline 1	14.80 (14.80)	717690	5.00	4.95	99	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	879990	5.00	5.18	104	No
Tetryl 1	15.20 (15.20)	146800	5.00	5.19	104	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	1118500	5.00	5.42	108	No
PETN 1	21.80 (21.80)	46991	5.00	5.11	102	No
RDX 1	9.94 (9.93)	150210	5.00	4.96	99	No
HMX 1	7.28 (7.28)	497870	5.00	4.78	96	No
C13_hmx 1	7.28 (7.25)	197870	5.00	4.78	96	No
2,4_dinitrotoluene 1	18.90 (18.90)	3697	5.00	4.93	99	No
2,6_dinitrotoluene 1	18.50 (18.50)	8302	5.00	5.46	109	No
2,6_dinitrotoluene 2	18.50 (18.50)	121240	5.00	5.61	112	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	4253100	5.00	5.23	105	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	1596700	5.00	5.18	104	No

8/2/12

8/2/12

Quantitative Peak Review — Explosives 5ppb



☐ Before ☐ After

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 10ppb	**Injection Vial**	5
Acquisition Date	7/30/2012 4:01:40 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23E	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	175080	10.00	10.30	103	No
1,3_dinitrobenzene 2	14.80 (14.80)	343550	10.00	10.60	106	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	285280	10.00	10.60	106	No
Dinitroanaline 1	14.80 (14.80)	1510100	10.00	10.30	103	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	1810000	10.00	10.60	106	No
Tetryl 1	15.20 (15.20)	304640	10.00	10.80	108	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	2147800	10.00	10.50	105	No
PETN 1	21.80 (21.80)	94226	10.00	10.20	102	No
RDX 1	9.92 (9.93)	315590	10.00	10.40	104	No
HMX 1	7.29 (7.28)	1112300	10.00	10.50	105	No
C13_hmx 1	7.28 (7.25)	446710	10.00	10.60	106	No
2,4_dinitrotoluene 1	18.90 (18.90)	7236	10.00	9.29	93	No
2,6_dinitrotoluene 1	18.50 (18.50)	16837	10.00	10.90	109	No
2,6_dinitrotoluene 2	18.50 (18.50)	229400	10.00	10.70	107	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	8428000	10.00	10.40	104	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	3261600	10.00	10.60	106	No

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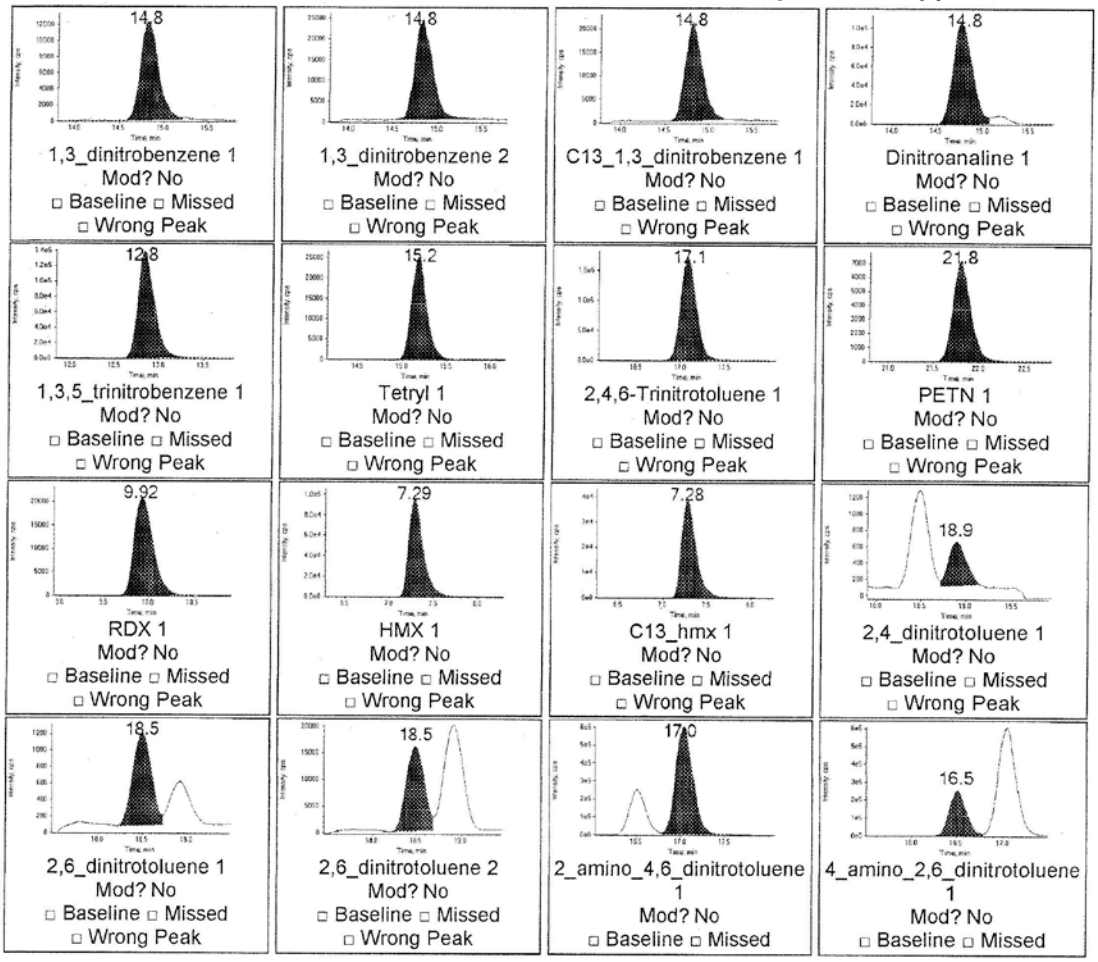
Quantitative Peak Review — Explosives 10ppb



☐ Before ☐ After

8/2/12

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 50ppb	**Injection Vial**	6
Acquisition Date	7/30/2012 4:28:18 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23F	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

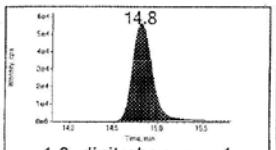
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	853840	50.00	49.20	99	No
1,3_dinitrobenzene 2	14.80 (14.80)	1664600	50.00	50.50	101	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	1404500	50.00	50.60	101	No
Dinitroanaline 1	14.70 (14.80)	7406000	50.00	50.50	101	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	9083800	50.00	53.00	106	No
Tetryl 1	15.20 (15.20)	1367400	50.00	48.10	96	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	10262000	50.00	50.00	100	No
PETN 1	21.80 (21.80)	481820	50.00	50.60	101	No
RDX 1	9.90 (9.93)	1584700	50.00	51.20	102	No
HMX 1	7.27 (7.28)	5391600	50.00	49.70	99	No
C13_hmx 1	7.26 (7.25)	2207200	50.00	50.00	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	40258	50.00	50.00	100	No
2,6_dinitrotoluene 1	18.50 (18.50)	89520	50.00	53.90	108	No
2,6_dinitrotoluene 2	18.50 (18.50)	1222700	50.00	53.70	107	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	38461000	50.00	51.40	103	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	15342000	50.00	51.00	102	No

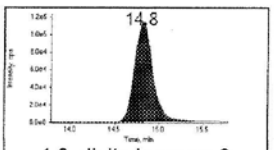
MM 8/10/12

8/2/12

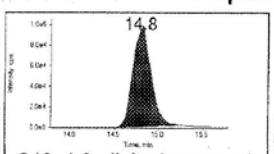
Quantitative Peak Review — Explosives 50ppb



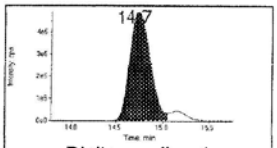
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



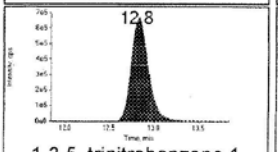
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



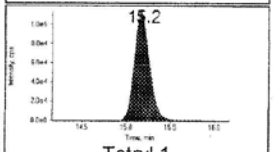
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



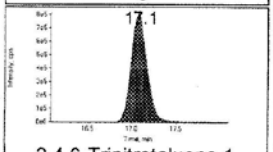
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



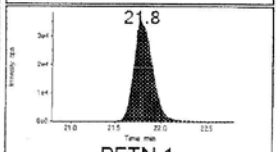
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



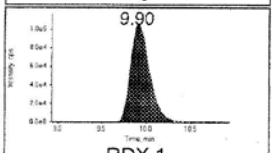
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



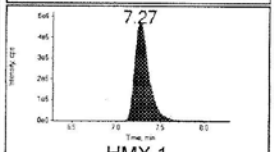
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



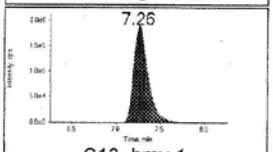
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



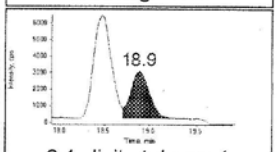
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



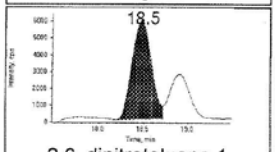
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



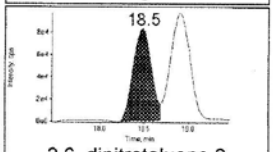
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



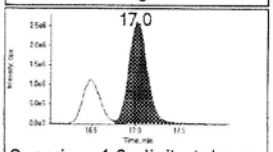
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



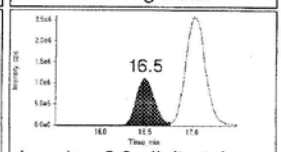
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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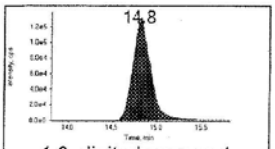
Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb	**Injection Vial**	7
Acquisition Date	7/30/2012 4:54:57 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

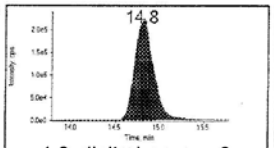
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1799000	100.00	100.00	100	No
1,3_dinitrobenzene 2	14.80 (14.80)	3327900	100.00	97.90	98	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2834600	100.00	98.40	98	No
Dinitroanaline 1	14.70 (14.80)	14384000	100.00	98.70	99	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16106000	100.00	94.20	94	No
Tetryl 1	15.20 (15.20)	2946000	100.00	101.00	101	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	20404000	100.00	98.60	99	No
PETN 1	21.80 (21.80)	974460	100.00	98.80	99	No
RDX 1	9.91 (9.93)	3083700	100.00	97.80	98	No
HMX 1	7.27 (7.28)	10999000	100.00	100.00	100	No
C13_hmx 1	7.27 (7.25)	4577300	100.00	99.50	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	75162	100.00	93.00	93	No
2,6_dinitrotoluene 1	18.50 (18.50)	164720	100.00	93.30	93	No
2,6_dinitrotoluene 2	18.50 (18.50)	2254200	100.00	93.50	94	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	65185000	100.00	95.80	96	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	28460000	100.00	97.00	97	No

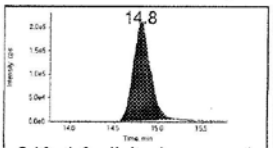
Quantitative Peak Review — Explosives 100ppb



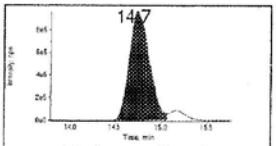
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



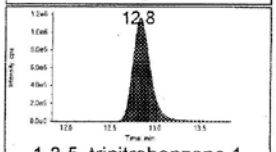
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



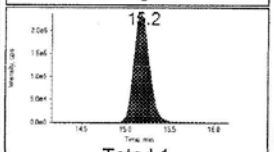
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



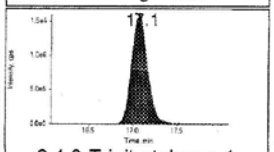
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



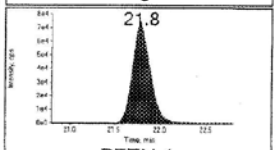
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



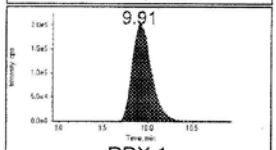
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



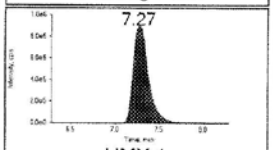
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



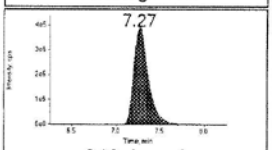
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



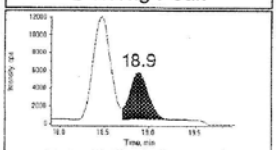
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



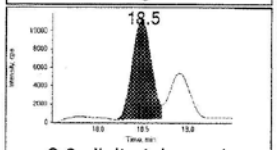
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



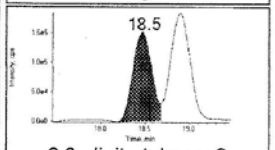
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



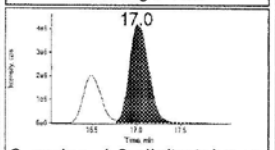
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



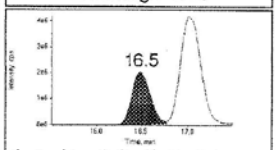
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

8/2/12

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

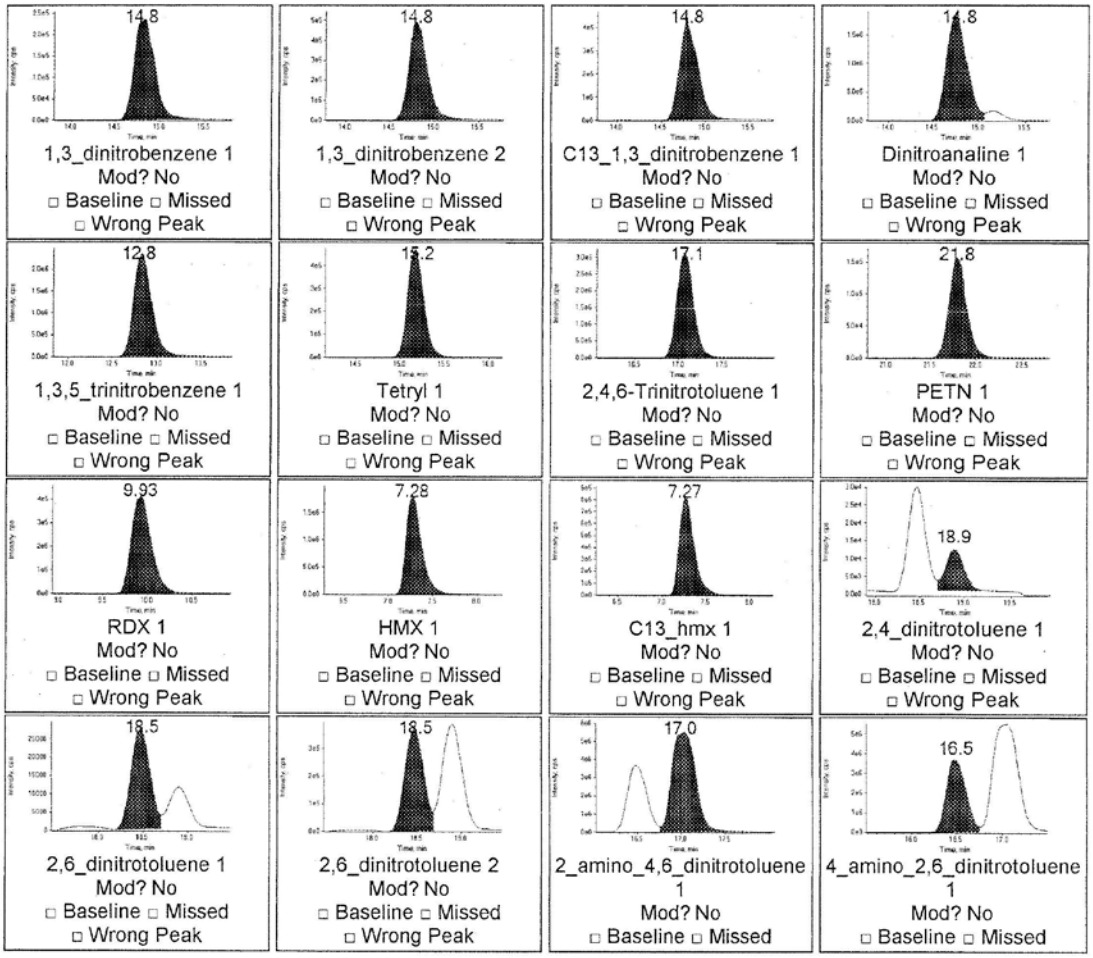
Sample Name	Explosives 200ppb	**Injection Vial**	8
Acquisition Date	7/30/2012 5:21:39 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Standard
Sample ID	12-OLC-01-23H	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	3813400	200.00	200.00	100	No
1,3_dinitrobenzene 2	14.80 (14.80)	7280200	200.00	201.00	100	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	6248600	200.00	201.00	100	No
Dinitroanaline 1	14.80 (14.80)	28844000	200.00	201.00	100	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	34281000	200.00	202.00	101	No
Tetryl 1	15.20 (15.20)	6073100	200.00	200.00	100	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	42338000	200.00	201.00	100	No
PETN 1	21.80 (21.80)	2122000	200.00	200.00	100	No
RDX 1	9.93 (9.93)	6579000	200.00	201.00	100	No
HMX 1	7.28 (7.28)	22548000	200.00	200.00	100	No
C13_hmx 1	7.27 (7.25)	9936700	200.00	200.00	100	No
2,4_dinitrotoluene 1	18.90 (18.90)	168310	200.00	208.00	104	No
2,6_dinitrotoluene 1	18.50 (18.50)	414560	200.00	202.00	101	No
2,6_dinitrotoluene 2	18.50 (18.50)	5623400	200.00	202.00	101	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	105280000	200.00	204.00	102	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	55657000	200.00	201.00	101	No

MHB 8/10/12 8/2/12

Quantitative Peak Review — Explosives 200ppb



☐ Before ☐ After

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Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb ICV	**Injection Vial**	9
Acquisition Date	7/30/2012 6:41:40 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23K	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	2278900	100.00	125.00	125	No
1,3_dinitrobenzene 2	14.80 (14.80)	4163600	100.00	121.00	121	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	3409900	100.00	117.00	117	No
Dinitroanaline 1	14.70 (14.80)	16330000	100.00	112.00	112	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	19454000	100.00	114.00	114	No
Tetryl 1	15.20 (15.20)	3573300	100.00	122.00	122	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	25539000	100.00	123.00	123	No
PETN 1	21.80 (21.80)	1109400	100.00	111.00	111	No
RDX 1	9.92 (9.93)	3468900	100.00	110.00	110	No
HMX 1	7.28 (7.28)	12443000	100.00	113.00	113	No
C13_hmx 1	7.27 (7.25)	4889600	100.00	106.00	106	No
2,4_dinitrotoluene 1	18.90 (18.90)	90915	100.00	112.00	112	No
2,6_dinitrotoluene 1	18.50 (18.50)	214560	100.00	117.00	117	No
2,6_dinitrotoluene 2	18.50 (18.50)	2855600	100.00	115.00	115	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	76451000	100.00	118.00	118	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	33311000	100.00	115.00	115	No

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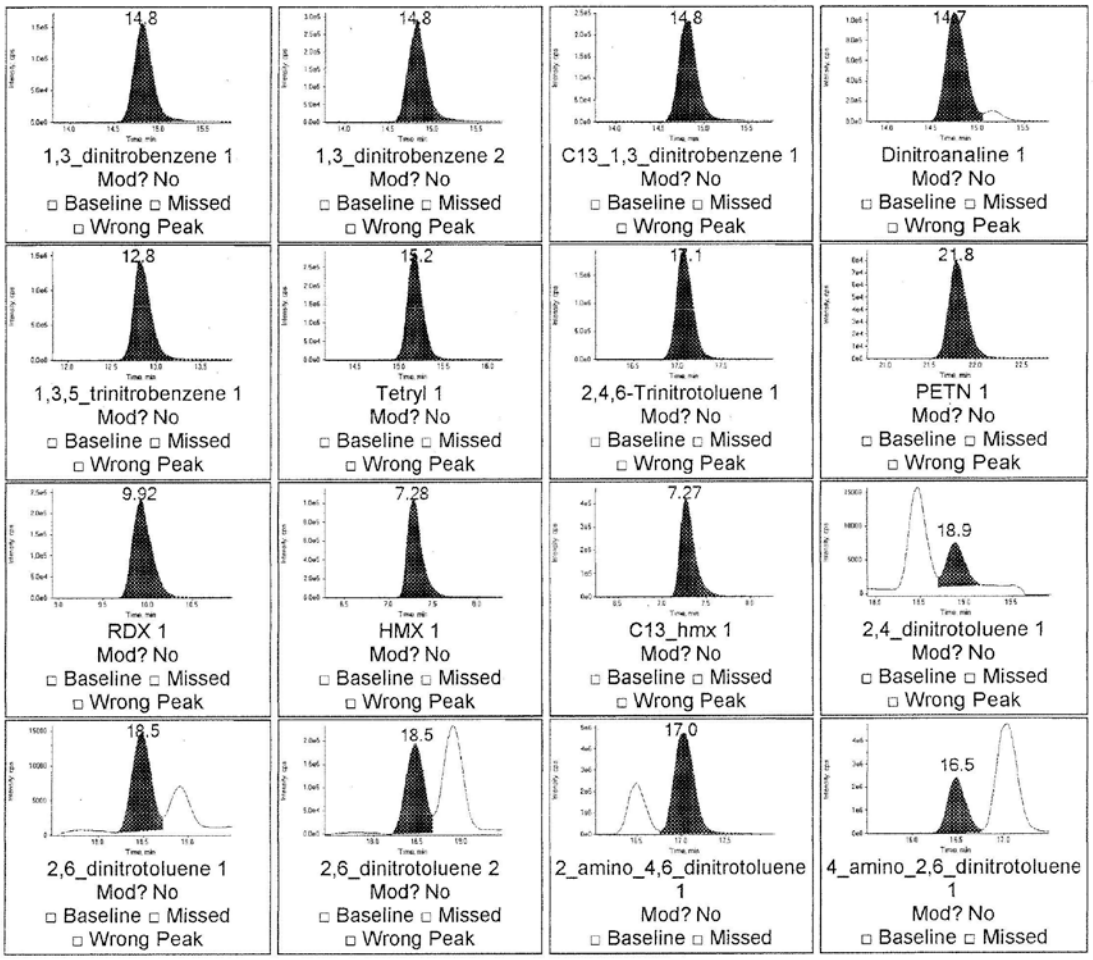
Quantitative Peak Review — Explosives 100ppb ICV



☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	113	NA	NA	NA	12.8	± 30 %	Quadratic
RDX	100	110	NA	NA	NA	9.5	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	114	NA	NA	NA	14.0	± 30 %	Quadratic
1,3-Dinitrobenzene	100	125	NA	NA	NA	25.2	± 30 %	Quadratic
Tetryl	100	122	NA	NA	NA	21.6	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	123	NA	NA	NA	22.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	115	NA	NA	NA	14.7	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	118	NA	NA	NA	18.2	± 30 %	Quadratic
2,4-Dinitrotoluene	100	112	NA	NA	NA	12.4	± 30 %	Linear
2,6-Dinitrotoluene	100	117	NA	NA	NA	17.3	± 30 %	Quadratic
3,5-Dinitroaniline	100	112	NA	NA	NA	12.2	± 30 %	Quadratic
C13-HMX	100	106	NA	NA	NA	5.8	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	117	NA	NA	NA	16.7	± 30 %	Quadratic
PETN	100	111	NA	NA	NA	11.4	± 30 %	Quadratic

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

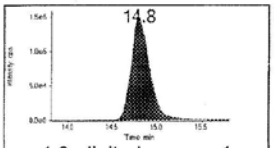
Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/30/2012 6:15:01 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

Results Summary

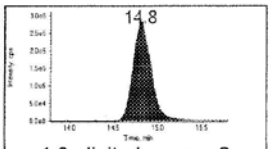
Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	2140200	100.00	118.00	118	No
1,3_dinitrobenzene 2	14.80 (14.80)	4054500	100.00	118.00	118	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	3346200	100.00	115.00	115	No
Dinitroanaline 1	14.70 (14.80)	14997000	100.00	103.00	103	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	18897000	100.00	111.00	111	No
Tetryl 1	15.10 (15.20)	3355600	100.00	115.00	115	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	23192000	100.00	112.00	112	No
PETN 1	21.80 (21.80)	1047300	100.00	106.00	106	No
RDX 1	9.90 (9.93)	3217200	100.00	102.00	102	No
HMX 1	7.27 (7.28)	12315000	100.00	112.00	112	No
C13_hmx 1	7.26 (7.25)	5053600	100.00	109.00	109	No
2,4_dinitrotoluene 1	18.90 (18.90)	98820	100.00	122.00	122	No
2,6_dinitrotoluene 1	18.50 (18.50)	246260	100.00	132.00	132	No
2,6_dinitrotoluene 2	18.50 (18.50)	3311500	100.00	130.00	130	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	70770000	100.00	107.00	107	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	30712000	100.00	105.00	105	No

8/2/12

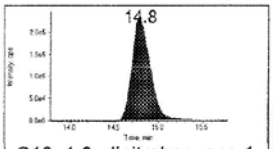
Quantitative Peak Review **Explosives 100ppb CCV**



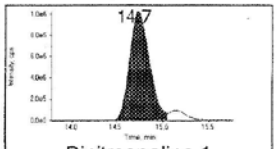
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



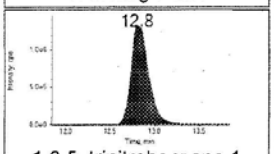
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



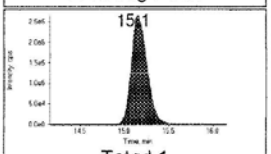
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



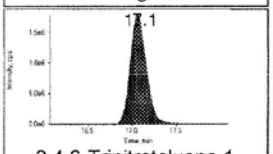
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



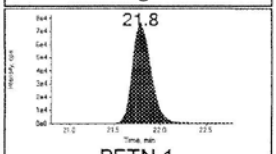
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



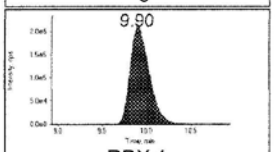
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



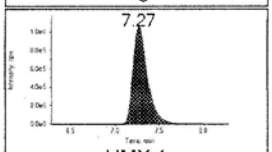
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



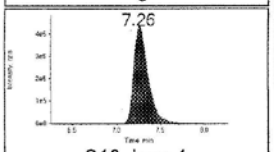
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



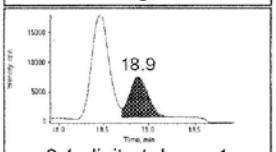
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



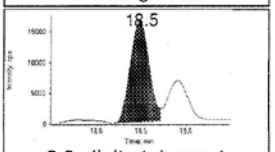
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



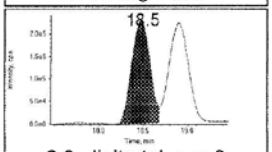
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



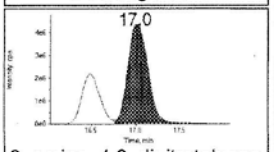
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



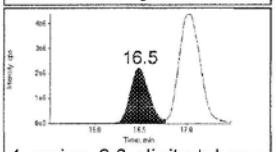
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

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Project	Ewan's Projects\Explosives
Data File	073012\Calib.wiff
Result Table	073012.rdb
Instrument Name	LCMS02

Sample Name	IB	**Injection Volume**	100
Acquisition Date	7/30/2012 5:48:19 PM	**Sample Type**	Unknown
Acquisition Method	Explosives_SchMRM_2012.dam	**Dilution Factor**	1.00
Injection Vial	1	**Weight to Volume**	0.00

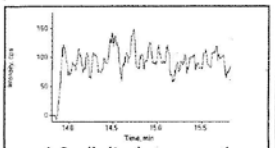
Results Summary

Analyte Peak Name	RT (Exp RT)	Area	Calc. Conc (ng/mL)	Modified?
1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	No
1,3_dinitrobenzene 2	0.00 (14.80)	0	N/A	No
C13_1,3_dinitrobenzene 1	0.00 (14.80)	0	N/A	Yes
Dinitroanaline 1	14.80 (14.80)	18333	0.22	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	12662	0.14	No
Tetryl 1	15.20 (15.20)	3131	0.03	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	15631	N/A	No
PETN 1	21.90 (21.80)	909	0.10	No
RDX 1	9.94 (9.93)	2685	0.11	No
HMX 1	7.27 (7.28)	11367	0.26	No
C13_hmx 1	0.00 (7.25)	0	N/A	No
2,4_dinitrotoluene 1	0.00 (18.90)	0	N/A	No
2,6_dinitrotoluene 1	0.00 (18.50)	0	N/A	No
2,6_dinitrotoluene 2	0.00 (18.50)	0	N/A	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	109260	0.16	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	44123	0.14	No

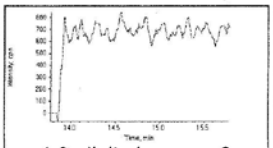
8/2/12

Quantitative Peak Review

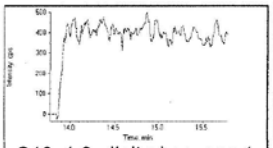
IB



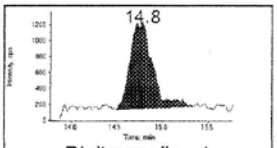
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



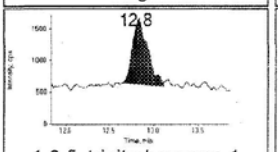
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



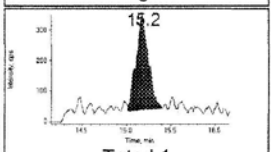
C13_1,3_dinitrobenzene 1
Mod? Yes
☐ Baseline ☐ Missed
☐ Wrong Peak



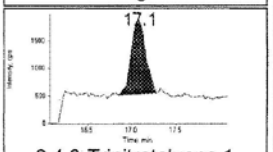
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



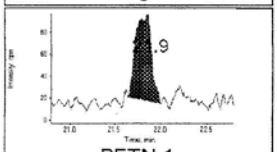
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



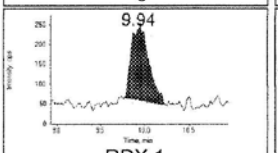
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



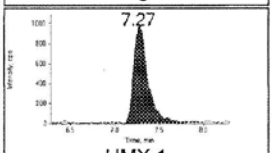
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



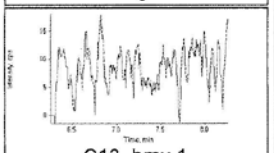
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



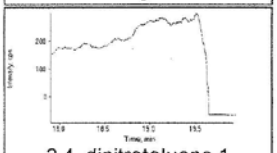
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



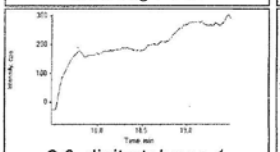
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



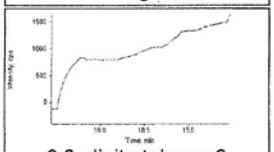
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



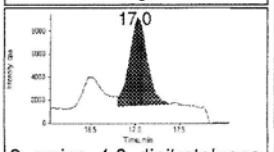
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



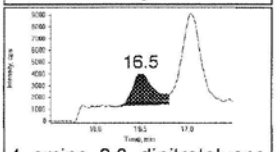
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/30/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	95.3	NA	NA	NA	-4.7	± 30 %	Quadratic
RDX	100	86.6	NA	NA	NA	-13.4	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	99.1	NA	NA	NA	-0.9	± 30 %	Quadratic
1,3-Dinitrobenzene	100	106	NA	NA	NA	6.2	± 30 %	Quadratic
Tetryl	100	96.9	NA	NA	NA	-3.1	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	104	NA	NA	NA	3.8	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	99.5	NA	NA	NA	-0.5	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	100	NA	NA	NA	0.0	± 30 %	Quadratic
2,4-Dinitrotoluene	100	83.1	NA	NA	NA	-16.9	± 30 %	Linear
2,6-Dinitrotoluene	100	115	NA	NA	NA	15.0	± 30 %	Quadratic
3,5-Dinitroaniline	100	99.0	NA	NA	NA	-1.0	± 30 %	Quadratic
C13-HMX	100	91.7	NA	NA	NA	-8.3	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	103	NA	NA	NA	3.0	± 30 %	Quadratic
PETN	100	95.9	NA	NA	NA	-4.1	± 30 %	Quadratic

Columbia Analytical Services

Created with Analyst Reporter
Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/30/2012 11:34:55 PM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

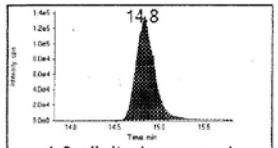
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1910500	100.00	106.00	106	No
1,3_dinitrobenzene 2	14.80 (14.80)	3652300	100.00	107.00	107	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2979100	100.00	103.00	103	No
Dinitroanaline 1	14.80 (14.80)	14426000	100.00	99.00	99	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16932000	100.00	99.10	99	No
Tetryl 1	15.20 (15.20)	2815000	100.00	96.90	97	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	21508000	100.00	104.00	104	No
PETN 1	21.80 (21.80)	944280	100.00	95.90	96	No
RDX 1	9.93 (9.93)	2718400	100.00	86.60	87	No
HMX 1	7.28 (7.28)	10471000	100.00	95.30	95	No
C13_hmx 1	7.28 (7.25)	4191400	100.00	91.70	92	No
2,4_dinitrotoluene 1	18.90 (18.90)	67173	100.00	83.10	83	No
2,6_dinitrotoluene 1	18.50 (18.50)	209540	100.00	115.00	115	No
2,6_dinitrotoluene 2	18.50 (18.50)	2738700	100.00	111.00	111	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	67422000	100.00	100.00	100	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	29137000	100.00	99.50	100	No

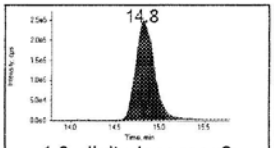
8/2/12

8/2/12

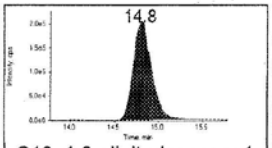
Quantitative Peak Review **Explosives 100ppb CCV**



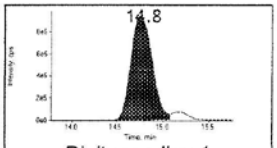
1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



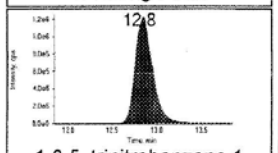
1,3_dinitrobenzene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



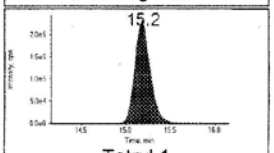
C13_1,3_dinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



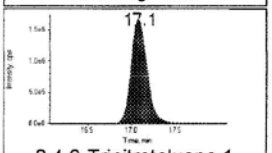
Dinitroanaline 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



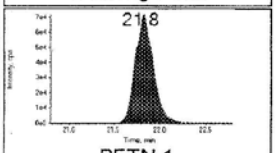
1,3,5_trinitrobenzene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



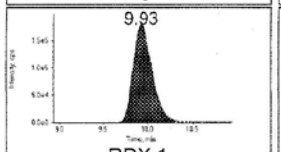
Tetryl 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



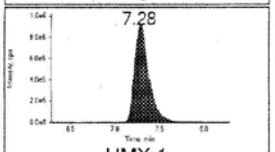
2,4,6-Trinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



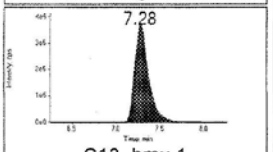
PETN 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



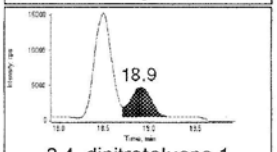
RDX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



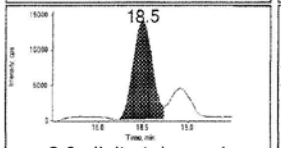
HMX 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



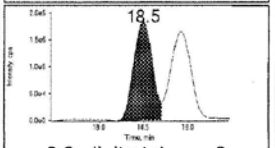
C13_hmx 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



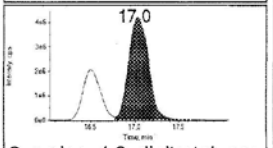
2,4_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



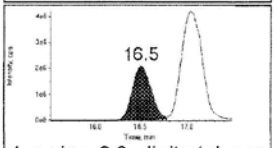
2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2,6_dinitrotoluene 2
Mod? No
☐ Baseline ☐ Missed
☐ Wrong Peak



2_amino_4,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed



4_amino_2,6_dinitrotoluene 1
Mod? No
☐ Baseline ☐ Missed

☐ Before ☐ After

COLUMBIA ANALYTICAL SERVICES, INC.
Now part of the ALS Group
QA/QC Report

Client: US Environmental Protection Agency
Project: Explosive Residue

Service Request: K1206333
Date Analyzed: 7/31/12

Continuing Calibration Verification Summary
Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Analytical Method: CAS SOP

File ID: 073012\Calib.wiff

Calibration Date: 7/30/12
Calibration ID: KC1200067
Analysis Lot: 302794
Units: ng/mL

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
HMX	100	85.2	NA	NA	NA	-14.8	± 30 %	Quadratic
RDX	100	80.8	NA	NA	NA	-19.2	± 30 %	Quadratic
1,3,5-Trinitrobenzene	100	94.4	NA	NA	NA	-5.6	± 30 %	Quadratic
1,3-Dinitrobenzene	100	101	NA	NA	NA	0.9	± 30 %	Quadratic
Tetryl	100	94.6	NA	NA	NA	-5.4	± 30 %	Quadratic
2,4,6-Trinitrotoluene (TNT)	100	100	NA	NA	NA	0.1	± 30 %	Quadratic
4-Amino-2,6-dinitrotoluene	100	98.8	NA	NA	NA	-1.2	± 30 %	Quadratic
2-Amino-4,6-dinitrotoluene	100	95.6	NA	NA	NA	-4.4	± 30 %	Quadratic
2,4-Dinitrotoluene	100	104	NA	NA	NA	3.8	± 30 %	Linear
2,6-Dinitrotoluene	100	106	NA	NA	NA	5.7	± 30 %	Quadratic
3,5-Dinitroaniline	100	94.2	NA	NA	NA	-5.8	± 30 %	Quadratic
C13-HMX	100	84.3	NA	NA	NA	-15.7	± 30 %	Quadratic
1,3-Dinitrobenzene-C13	100	101	NA	NA	NA	0.6	± 30 %	Quadratic
PETN	100	93.3	NA	NA	NA	-6.7	± 30 %	Quadratic

Columbia Analytical Services

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Printed: 8/2/2012 7:45 AM

Project	Ewan's Projects\Explosives	**Result Table**	073012.rdb
Data File	073012\Calib.wiff	**Algorithm Used**	MQL
Acquisition Method	Explosives_SchMRM_2012.dam	**Instrument Name**	LCMS02

Sample Name	Explosives 100ppb CCV	**Injection Vial**	7
Acquisition Date	7/31/2012 4:28:05 AM	**Injection Volume**	100
Acquisition Method	Explosives_SchMRM_2012.dam	**Sample Type**	Quality Control
Sample ID	12-OLC-01-23G	**Dilution Factor**	1.00
Sample Comment		**Weight to Volume**	0.00

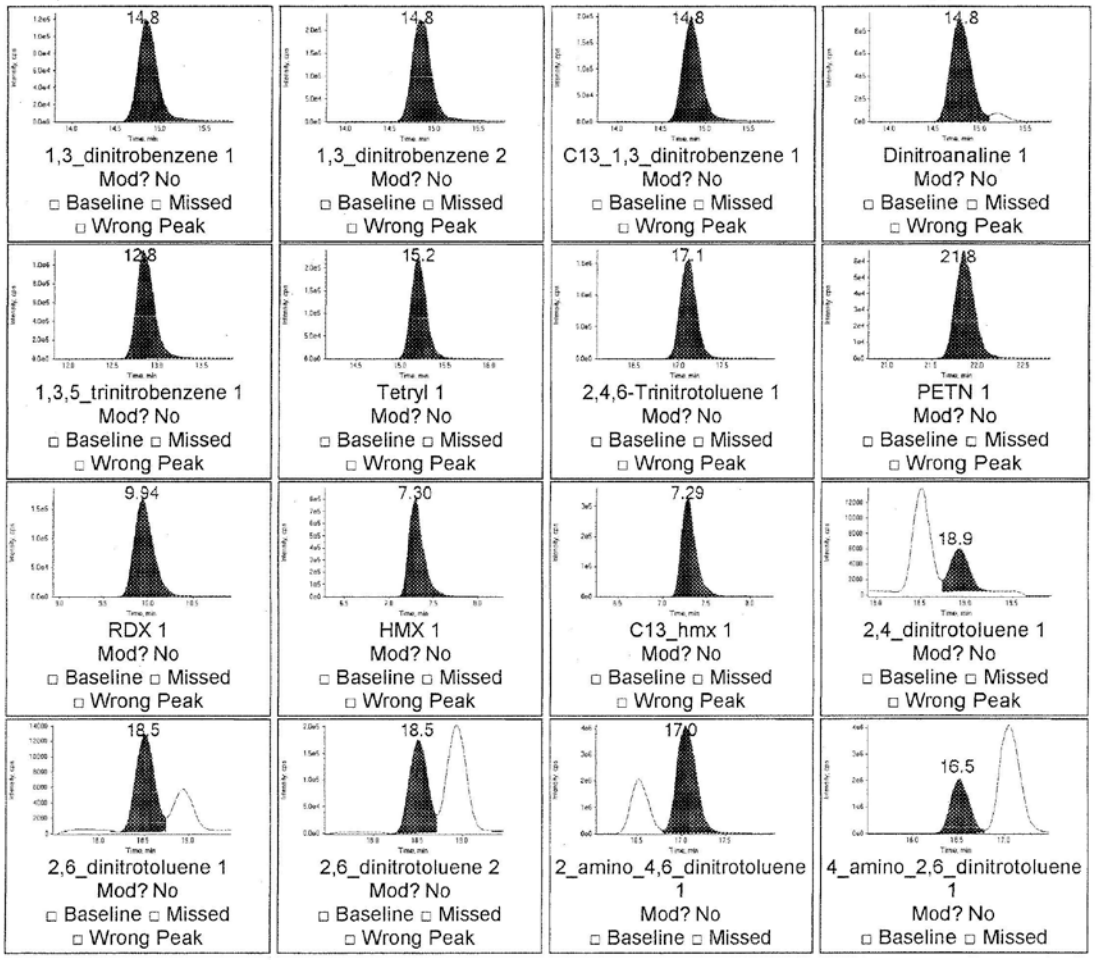
Results Summary

Analyte Peak Name	RT (Expected)	Area	Exp Conc (ng/mL)	Calc. Conc (ng/mL)	Accuracy (%)	Modified?
1,3_dinitrobenzene 1	14.80 (14.80)	1809300	100.00	101.00	101	No
1,3_dinitrobenzene 2	14.80 (14.80)	3464600	100.00	102.00	102	No
C13_1,3_dinitrobenzene 1	14.80 (14.80)	2904300	100.00	101.00	101	No
Dinitroanaline 1	14.80 (14.80)	13737000	100.00	94.20	94	No
1,3,5_trinitrobenzene 1	12.80 (12.80)	16134000	100.00	94.40	94	No
Tetryl 1	15.20 (15.20)	2747600	100.00	94.60	95	No
2,4,6-Trinitrotoluene 1	17.10 (17.10)	20734000	100.00	100.00	100	No
PETN 1	21.80 (21.80)	917040	100.00	93.30	93	No
RDX 1	9.94 (9.93)	2530100	100.00	80.80	81	No
HMX 1	7.30 (7.28)	9337400	100.00	85.20	85	No
C13_hmx 1	7.29 (7.25)	3829800	100.00	84.30	84	No
2,4_dinitrotoluene 1	18.90 (18.90)	83967	100.00	104.00	104	No
2,6_dinitrotoluene 1	18.50 (18.50)	190140	100.00	106.00	106	No
2,6_dinitrotoluene 2	18.50 (18.50)	2575600	100.00	105.00	105	No
2_amino_4,6_dinitrotoluene 1	17.00 (17.00)	65096000	100.00	95.60	96	No
4_amino_2,6_dinitrotoluene 1	16.50 (16.50)	28963000	100.00	98.80	99	No

* 8/2/12

8/8/10

Quantitative Peak Review — Explosives 100ppb CCV



☐ Before ☐ After

Organics Analysis:

Nitroaromatics and Nitramines by Liquid Chromatography and Tandem Mass Spectrometry

Validation Package

Sample Prep and Screen Data

Date: 7/30/12

Columbia Analytical Services, Inc.

Injection Log

LCMS02 - API 5000

ICAL Date: 7/30/12

ICAL ID: KC1200067

LIMS ID: 302794

By: dhaderly 8/1/12

2nd Review: 8/10/12

Column: phenomenex Synergi 4µ Hydro-RP 80A 250 x 2.0 mm 4µ S/N 599693-2

Mobile Phases A: 5mM NH_4OAc H_2O EFS 8/1/12 B: 8:2 MeOH : ACN EFS 8/1/12

Project Folder: D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012

	Sample Name	File Name	Acquisition Method	Dilution	R	Comments
1	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
2	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
3	Explosives 1ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
4	Explosives 2ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
5	Explosives 5ppb ←	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
6	Explosives 10ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
7	Explosives 50ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
8	Explosives 100ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
9	Explosives 200ppb	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
10	IB	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	
11	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	6:25 pm
12	Explosives 100ppb ICV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	6:41 pm
13	K1206334-001	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
14	K1206334-002	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
15	K1206334-003	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
16	K1206334-004	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
17	K1206334-005	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
18	K1206334-006	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
19	K1206334-007	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
20	K1206334-008	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
21	K1206334-009	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
22	K1206334-010	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
23	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	7:34 pm
24	K1206334-011	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
25	K1206334-012	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
26	K1206334-013	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
27	K1206334-014	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
28	K1206334-015	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
29	K1206334-016	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
30	K1206334-017	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	

Date: 7/30/12

Columbia Analytical Services, Inc.

Injection Log

LCMS02 - API 5000

ICAL Date: 7/30/12

By: dhaderly

ICAL ID:

2nd Review: MM 8/16/12

LIMS ID: 302794

Column: See Pg. 1

Mobile Phases **A:** **B:**

Project Folder: D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012

	Sample Name	File Name	Acquisition Method	Dilution	R	Comments
1	KQ1207704-01	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
2	KQ1207704-02	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
3	KQ1207704-03	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
4	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	428am
5	K1206333-001	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
6	K1206333-002	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
7	K1206333-003	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
8	K1206333-004	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
9	K1206333-005	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
10	KQ1207790-01	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
11	KQ1207790-02	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
12	KQ1207790-03	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
13	KQ1207790-04	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
14	KQ1207790-05	073012\Spl.wiff	Explosives_SchMRM_2012	1	X	
15	Explosives 100ppb CCV	073012\Calib.wiff	Explosives_SchMRM_2012	1	X	9:21
16						
17						
18						
19						
20						
21						
22						
23			MM 8/10/12			
24						
25						
26						
27						
28						
29						
30						

D:\Analyst Data\Projects\Ewan's Projects\Explosives\Data\073012\INJLOG_LCMS02.XLS

Appendix M: Laboratory Reports for Metal Analyzes

ARCADIS

CLIENT # A053
REPORT # 12-568

SUBMITTED BY:
CHESTER LabNet
12242 S.W. GARDEN PLACE
TIGARD, OR 97223
(503)624-2183/FAX (503)624-2653
www.ChesterLab.Net

CHESTER LabNet

12242 SW Garden Place ❖ Tigard, OR 97223-8246 ❖ USA
Telephone 503-624-2183 ❖ Fax 503-624-2653 ❖ www.chesterlab.net

Case Narrative

Date: January 18, 2013

General Information

Client:	Arcadis
Client Number:	A053
Report Number:	12-568
Sample Description:	47mm Teflon filters, 47mm Polycarbonate filters

Analysis

Analytes:	Particulate Mass, XRF Metals (Na – Pb), Al, Ca, Fe, Hf, K, Mg, Mn, Na, Pb, Zr
Analytical Protocols:	Gravimetry Digestion: IO-3.1, X-Ray Fluorescence: IO-3.3, ICP: IO-3.4
Analytical Notes:	The filters were heavily loaded and contained significant amounts of loose particulate matter. The Teflon filters were weighed and reweighed several times and never had reweights within the normal QC limits. Then weights reported are from the fourth weighing session. Since the samples must be turned upside down for XRF analysis, the excess deposit was tapped off the samples prior to XRF analysis. The filters were reweighed after the metals analysis in order to determine how much deposit was left out of the XRF analysis. The XRF results are biased low because of the lost deposit. The post-XRF reweight data is in contained in the QA/QC section of this report. The polycarbonate filters also had loose deposits. The loose particulate matter for those samples was included in the digestion for the ICP analysis. The results for these samples should not be biased low since all the PM was included in the digestion. Results have **not** been blank corrected.
QA/QC Review:	All of the data have been reviewed by the analysts performing the analyses and the project manager. All of the quality control and sample-specific information in this package is complete and meets or exceeds the minimum requirements for acceptability.
Comments:	If you have any questions or concerns regarding this analysis, please feel free to contact the project manager.
Disclaimer:	This report shall not be reproduced, except in full, without the written approval of the laboratory. The results only represent that of the samples as received into the laboratory.

Paul Duda 1/18/13

Project Manager Date
Paul Duda

Data Summary

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1302
Client ID: PS-OD-PM2.5-061612-01
Filter ID: P0219199
Sample Date: 6/16/12
Filter Lot #: 45155
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	10,612.	±	10.			
XRF						
* Na	0.0000	±	55.09	0.0000	±	0.5191
* Mg	16.32	±	10.82	0.1538	±	0.1020
Al	121.8	±	17.84	1.148	±	0.1681
Si	956.4	±	101.2	9.013	±	0.9534
P	1.502	±	0.2757	0.0142	±	0.0026
S	0.5153	±	0.1503	0.0049	±	0.0014
* Cl	0.1785	±	0.1119	0.0017	±	0.0011
K	42.82	±	2.370	0.4035	±	0.0223
Ca	64.30	±	3.469	0.6059	±	0.0327
Ti	4.210	±	0.2226	0.0397	±	0.0021
V	0.1266	±	0.0294	0.0012	±	0.0003
Cr	0.1390	±	0.0181	0.0013	±	0.0002
Mn	0.8068	±	0.0475	0.0076	±	0.0004
Fe	40.49	±	2.032	0.3815	±	0.0191
* Co	0.0000	±	0.0226	0.0000	±	0.0002
* Ni	0.0000	±	0.0090	0.0000	±	0.0001
Cu	0.0655	±	0.0102	0.0006	±	0.0001
Zn	0.0938	±	0.0113	0.0009	±	0.0001
Ga	0.0260	±	0.0079	0.0002	±	0.0001
* Ge	0.0090	±	0.0079	0.0001	±	0.0001
As	0.0644	±	0.0079	0.0006	±	0.0001
* Se	0.0113	±	0.0068	0.0001	±	0.0001
* Br	0.0147	±	0.0056	0.0001	±	0.0001
Rb	0.1842	±	0.0124	0.0017	±	0.0001
Sr	0.4599	±	0.0249	0.0043	±	0.0002
Y	0.0554	±	0.0102	0.0005	±	0.0001
Zr	0.2452	±	0.0181	0.0023	±	0.0002
* Mo	0.0000	±	0.0181	0.0000	±	0.0002
* Pd	0.0362	±	0.0373	0.0003	±	0.0004
* Ag	0.0000	±	0.0384	0.0000	±	0.0004
* Cd	0.0000	±	0.0373	0.0000	±	0.0004
* In	0.0000	±	0.0418	0.0000	±	0.0004
* Sn	0.0000	±	0.0497	0.0000	±	0.0005
* Sb	0.0000	±	0.0554	0.0000	±	0.0005
Ba	1.928	±	0.1503	0.0182	±	0.0014
* La	0.0000	±	0.1288	0.0000	±	0.0012
* Hf	0.0056	±	0.0316	0.0001	±	0.0003
* Hg	0.0000	±	0.0181	0.0000	±	0.0002
* Pb	0.0237	±	0.0170	0.0002	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1803
Client ID: PS-OD-PM2.5-061612-02
Filter ID: P0458953
Sample Date: 6/16/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	7,260.	±	10.			
XRF						
* Na	0.0000	±	37.14	0.0000	±	0.5116
* Mg	9.075	±	7.126	0.1250	±	0.0982
Al	95.51	±	11.65	1.316	±	0.1605
Si	907.4	±	82.74	12.50	±	1.140
P	1.327	±	0.2305	0.0183	±	0.0032
* S	0.2893	±	0.1288	0.0040	±	0.0018
* Cl	0.3153	±	0.1085	0.0043	±	0.0015
K	37.71	±	2.053	0.5194	±	0.0283
Ca	73.34	±	5.560	1.010	±	0.0766
Ti	3.821	±	0.2034	0.0526	±	0.0028
V	0.1096	±	0.0294	0.0015	±	0.0004
Cr	0.1186	±	0.0181	0.0016	±	0.0002
Mn	0.7017	±	0.0418	0.0097	±	0.0006
Fe	39.08	±	1.962	0.5382	±	0.0270
* Co	0.0000	±	0.0215	0.0000	±	0.0003
* Ni	0.0056	±	0.0090	0.0001	±	0.0001
Cu	0.1175	±	0.0113	0.0016	±	0.0002
Zn	0.0994	±	0.0113	0.0014	±	0.0002
* Ga	0.0170	±	0.0079	0.0002	±	0.0001
* Ge	0.0079	±	0.0079	0.0001	±	0.0001
* As	0.0136	±	0.0113	0.0002	±	0.0002
* Se	0.0023	±	0.0056	0.0000	±	0.0001
* Br	0.0102	±	0.0056	0.0001	±	0.0001
Rb	0.1593	±	0.0113	0.0022	±	0.0002
Sr	0.4531	±	0.0249	0.0062	±	0.0003
Y	0.0418	±	0.0102	0.0006	±	0.0001
Zr	0.2542	±	0.0181	0.0035	±	0.0002
* Mo	0.0079	±	0.0170	0.0001	±	0.0002
* Pd	0.0000	±	0.0362	0.0000	±	0.0005
* Ag	0.0000	±	0.0373	0.0000	±	0.0005
* Cd	0.0000	±	0.0373	0.0000	±	0.0005
* In	0.0000	±	0.0418	0.0000	±	0.0006
* Sn	0.0000	±	0.0486	0.0000	±	0.0007
* Sb	0.0000	±	0.0542	0.0000	±	0.0007
Ba	1.785	±	0.1446	0.0246	±	0.0020
* La	0.0000	±	0.1266	0.0000	±	0.0017
* Hf	0.0000	±	0.0316	0.0000	±	0.0004
* Hg	0.0000	±	0.0170	0.0000	±	0.0002
Pb	0.0644	±	0.0170	0.0009	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1804
Client ID: PS-OD-PM2.5-061612-03
Filter ID: P0458954
Sample Date: 6/16/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed
hole outside of analysis area

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	4,435.	±	10.			
XRF						
* Na	0.0000	±	11.82	0.0000	±	0.2665
* Mg	6.342	±	3.046	0.1430	±	0.0687
Al	57.78	±	5.658	1.303	±	0.1276
Si	583.4	±	44.85	13.15	±	1.012
P	0.8509	±	0.1198	0.0192	±	0.0027
S	0.2701	±	0.0734	0.0061	±	0.0017
* Cl	0.1480	±	0.0723	0.0033	±	0.0016
K	23.32	±	1.240	0.5259	±	0.0280
Ca	45.71	±	2.385	1.031	±	0.0538
Ti	2.315	±	0.1277	0.0522	±	0.0029
* V	0.0429	±	0.0215	0.0010	±	0.0005
Cr	0.0881	±	0.0136	0.0020	±	0.0003
Mn	0.3898	±	0.0271	0.0088	±	0.0006
Fe	22.26	±	1.120	0.5019	±	0.0253
* Co	0.0000	±	0.0170	0.0000	±	0.0004
* Ni	0.0000	±	0.0079	0.0000	±	0.0002
Cu	0.1175	±	0.0102	0.0026	±	0.0002
Zn	0.0441	±	0.0090	0.0010	±	0.0002
Ga	0.0305	±	0.0079	0.0007	±	0.0002
* Ge	0.0113	±	0.0068	0.0003	±	0.0002
* As	0.0147	±	0.0102	0.0003	±	0.0002
* Se	0.0090	±	0.0056	0.0002	±	0.0001
Br	0.0181	±	0.0056	0.0004	±	0.0001
Rb	0.1017	±	0.0090	0.0023	±	0.0002
Sr	0.2678	±	0.0158	0.0060	±	0.0004
* Y	0.0136	±	0.0090	0.0003	±	0.0002
Zr	0.1842	±	0.0158	0.0042	±	0.0004
* Mo	0.0000	±	0.0170	0.0000	±	0.0004
* Pd	0.0000	±	0.0339	0.0000	±	0.0008
* Ag	0.0011	±	0.0350	0.0000	±	0.0008
* Cd	0.0000	±	0.0350	0.0000	±	0.0008
* In	0.0000	±	0.0396	0.0000	±	0.0009
* Sn	0.0000	±	0.0475	0.0000	±	0.0011
* Sb	0.0000	±	0.0531	0.0000	±	0.0012
Ba	1.095	±	0.0960	0.0247	±	0.0022
* La	0.0689	±	0.0734	0.0016	±	0.0017
* Hf	0.0000	±	0.0294	0.0000	±	0.0007
* Hg	0.0000	±	0.0158	0.0000	±	0.0004
* Pb	0.0316	±	0.0158	0.0007	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1806
Client ID: PS-OD-PM10-061612-01
Filter ID: P0458956
Sample Date: 6/16/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed
NUD-Cu

Analyte	µg/filter		percent	
Gravimetry				
Net Mass	8,739.	± 10.		
XRF				
* Na	0.0000	± 74.47	0.0000	± 0.8521
* Mg	23.00	± 16.16	0.2631	± 0.1849
Al	175.2	± 24.55	2.004	± 0.2810
Si	1511.	±157.2	17.29	± 1.799
P	2.679	± 0.4339	0.0307	± 0.0050
S	0.9854	± 0.2316	0.0113	± 0.0027
Cl	0.6577	± 0.1978	0.0075	± 0.0023
K	80.13	± 4.479	0.9169	± 0.0513
Ca	123.4	± 6.724	1.412	± 0.0770
Ti	8.249	± 0.4283	0.0944	± 0.0049
V	0.3582	± 0.0508	0.0041	± 0.0006
Cr	0.3096	± 0.0316	0.0035	± 0.0004
Mn	1.567	± 0.0859	0.0179	± 0.0010
Fe	82.69	± 4.141	0.9463	± 0.0474
* Co	0.0000	± 0.0316	0.0000	± 0.0004
* Ni	0.0316	± 0.0136	0.0004	± 0.0002
Cu	0.3108	± 0.0350	0.0036	± 0.0004
Zn	0.2113	± 0.0170	0.0024	± 0.0002
Ga	0.0429	± 0.0113	0.0005	± 0.0001
* Ge	0.0271	± 0.0102	0.0003	± 0.0001
* As	0.0441	± 0.0158	0.0005	± 0.0002
* Se	0.0034	± 0.0079	0.0000	± 0.0001
Br	0.0429	± 0.0079	0.0005	± 0.0001
Rb	0.3650	± 0.0215	0.0042	± 0.0002
Sr	0.9187	± 0.0486	0.0105	± 0.0006
Y	0.0825	± 0.0136	0.0009	± 0.0002
Zr	0.5469	± 0.0328	0.0063	± 0.0004
* Mo	0.0011	± 0.0215	0.0000	± 0.0002
* Pd	0.0316	± 0.0429	0.0004	± 0.0005
* Ag	0.0000	± 0.0441	0.0000	± 0.0005
* Cd	0.0000	± 0.0429	0.0000	± 0.0005
* In	0.0000	± 0.0475	0.0000	± 0.0005
* Sn	0.0000	± 0.0554	0.0000	± 0.0006
* Sb	0.0079	± 0.0633	0.0001	± 0.0007
Ba	3.418	± 0.2893	0.0391	± 0.0033
* La	0.0000	± 0.2350	0.0000	± 0.0027
* Hf	0.0000	± 0.0429	0.0000	± 0.0005
* Hg	0.0000	± 0.0237	0.0000	± 0.0003
Pb	0.1062	± 0.0226	0.0012	± 0.0003

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1809
Client ID: PS-OD-PM10-061612-03
Filter ID: P0458959
Sample Date: 6/16/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	5,864.	±	10.			
XRF						
* Na	0.0000	±	16.96	0.0000	±	0.2892
* Mg	7.533	±	4.108	0.1285	±	0.0700
Al	59.17	±	6.314	1.009	±	0.1077
Si	550.1	±	45.08	9.381	±	0.7689
P	0.7040	±	0.1175	0.0120	±	0.0020
S	0.3119	±	0.0757	0.0053	±	0.0013
Cl	0.2283	±	0.0678	0.0039	±	0.0012
K	21.64	±	1.156	0.3690	±	0.0197
Ca	41.56	±	2.179	0.7088	±	0.0372
Ti	2.252	±	0.1220	0.0384	±	0.0021
* V	0.0542	±	0.0192	0.0009	±	0.0003
Cr	0.0655	±	0.0124	0.0011	±	0.0002
Mn	0.3153	±	0.0237	0.0054	±	0.0004
Fe	18.37	±	0.9266	0.3133	±	0.0158
* Co	0.0000	±	0.0147	0.0000	±	0.0003
* Ni	0.0000	±	0.0068	0.0000	±	0.0001
Cu	0.0497	±	0.0079	0.0008	±	0.0001
Zn	0.0463	±	0.0079	0.0008	±	0.0001
Ga	0.0249	±	0.0079	0.0004	±	0.0001
* Ge	0.0136	±	0.0068	0.0002	±	0.0001
As	0.0384	±	0.0068	0.0007	±	0.0001
* Se	0.0068	±	0.0056	0.0001	±	0.0001
* Br	0.0102	±	0.0056	0.0002	±	0.0001
Rb	0.0848	±	0.0079	0.0014	±	0.0001
Sr	0.2667	±	0.0158	0.0045	±	0.0003
Y	0.0407	±	0.0090	0.0007	±	0.0002
Zr	0.1571	±	0.0136	0.0027	±	0.0002
* Mo	0.0068	±	0.0158	0.0001	±	0.0003
* Pd	0.0000	±	0.0328	0.0000	±	0.0006
* Ag	0.0000	±	0.0339	0.0000	±	0.0006
* Cd	0.0000	±	0.0339	0.0000	±	0.0006
* In	0.0000	±	0.0373	0.0000	±	0.0006
* Sn	0.0000	±	0.0463	0.0000	±	0.0008
* Sb	0.0034	±	0.0508	0.0001	±	0.0009
Ba	0.5684	±	0.0893	0.0097	±	0.0015
* La	0.0000	±	0.0667	0.0000	±	0.0011
* Hf	0.0339	±	0.0271	0.0006	±	0.0005
* Hg	0.0000	±	0.0158	0.0000	±	0.0003
* Pb	0.0079	±	0.0147	0.0001	±	0.0003

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1810
Client ID: PS-OD-PM10-061612-02
Filter ID: P0458960
Sample Date: 6/16/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter		percent	
Gravimetry				
Net Mass	10,511.	± 10.		
XRF				
* Na	0.0000	± 25.29	0.0000	± 0.2406
* Mg	10.49	± 9.943	0.0998	± 0.0946
Al	185.1	± 29.32	1.761	± 0.2790
Si	1933.	±222.2	18.39	± 2.114
P	3.302	± 0.5831	0.0314	± 0.0055
* S	0.6407	± 0.2927	0.0061	± 0.0028
* Cl	0.7424	± 0.2599	0.0071	± 0.0025
K	97.35	± 5.552	0.9262	± 0.0528
Ca	177.5	± 9.821	1.689	± 0.0934
Ti	10.03	± 0.5209	0.0954	± 0.0050
V	0.5175	± 0.0655	0.0049	± 0.0006
Cr	0.3898	± 0.0396	0.0037	± 0.0004
Mn	1.618	± 0.0893	0.0154	± 0.0008
Fe	92.25	± 4.621	0.8777	± 0.0440
* Co	0.0712	± 0.0350	0.0007	± 0.0003
* Ni	0.0294	± 0.0147	0.0003	± 0.0001
Cu	0.4091	± 0.0260	0.0039	± 0.0002
Zn	0.3006	± 0.0328	0.0029	± 0.0003
Ga	0.0475	± 0.0124	0.0005	± 0.0001
* Ge	0.0011	± 0.0136	0.0000	± 0.0001
As	0.0848	± 0.0181	0.0008	± 0.0002
* Se	0.0000	± 0.0090	0.0000	± 0.0001
Br	0.0373	± 0.0090	0.0004	± 0.0001
Rb	0.4791	± 0.0271	0.0046	± 0.0003
Sr	1.337	± 0.0689	0.0127	± 0.0007
Y	0.0904	± 0.0158	0.0009	± 0.0002
Zr	0.7978	± 0.0452	0.0076	± 0.0004
* Mo	0.0215	± 0.0237	0.0002	± 0.0002
* Pd	0.0000	± 0.0452	0.0000	± 0.0004
* Ag	0.0000	± 0.0463	0.0000	± 0.0004
* Cd	0.0090	± 0.0452	0.0001	± 0.0004
* In	0.0000	± 0.0508	0.0000	± 0.0005
* Sn	0.0000	± 0.0576	0.0000	± 0.0005
* Sb	0.0655	± 0.0655	0.0006	± 0.0006
Ba	4.850	± 0.3492	0.0461	± 0.0033
* La	0.0350	± 0.2983	0.0003	± 0.0028
* Hf	0.0000	± 0.0486	0.0000	± 0.0005
Hg	0.1175	± 0.0237	0.0011	± 0.0002
Pb	0.1390	± 0.0260	0.0013	± 0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1811
Client ID: PS-OD-PM2.5-061812-01
Filter ID: P0458961
Sample Date: 6/18/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,518.	±	10.			
XRF						
* Na	0.0000	±	4.128	0.0000	±	0.1639
Mg	4.323	±	1.309	0.1717	±	0.0520
Al	34.91	±	2.915	1.386	±	0.1159
Si	279.6	±	18.77	11.10	±	0.7467
P	0.2848	±	0.0644	0.0113	±	0.0026
S	0.1752	±	0.0452	0.0070	±	0.0018
* Cl	0.1333	±	0.0508	0.0053	±	0.0020
K	14.03	±	0.7322	0.5574	±	0.0292
Ca	23.00	±	1.183	0.9132	±	0.0471
Ti	1.493	±	0.0859	0.0593	±	0.0034
* V	0.0362	±	0.0170	0.0014	±	0.0007
Cr	0.0328	±	0.0102	0.0013	±	0.0004
Mn	0.2983	±	0.0226	0.0118	±	0.0009
Fe	14.44	±	0.7288	0.5735	±	0.0290
* Co	0.0000	±	0.0136	0.0000	±	0.0005
* Ni	0.0000	±	0.0068	0.0000	±	0.0003
Cu	0.0814	±	0.0090	0.0032	±	0.0004
Zn	0.0316	±	0.0079	0.0013	±	0.0003
* Ga	0.0090	±	0.0068	0.0004	±	0.0003
* Ge	0.0102	±	0.0068	0.0004	±	0.0003
* As	0.0000	±	0.0102	0.0000	±	0.0004
* Se	0.0158	±	0.0056	0.0006	±	0.0002
* Br	0.0113	±	0.0056	0.0004	±	0.0002
Rb	0.0644	±	0.0068	0.0026	±	0.0003
Sr	0.1627	±	0.0113	0.0065	±	0.0004
* Y	0.0045	±	0.0090	0.0002	±	0.0004
Zr	0.0893	±	0.0124	0.0035	±	0.0005
* Mo	0.0249	±	0.0158	0.0010	±	0.0006
* Pd	0.0000	±	0.0316	0.0000	±	0.0013
* Ag	0.0000	±	0.0328	0.0000	±	0.0013
* Cd	0.0000	±	0.0316	0.0000	±	0.0013
* In	0.0000	±	0.0362	0.0000	±	0.0014
* Sn	0.0000	±	0.0429	0.0000	±	0.0017
* Sb	0.0000	±	0.0497	0.0000	±	0.0020
Ba	0.6498	±	0.0689	0.0258	±	0.0027
* La	0.0000	±	0.0520	0.0000	±	0.0021
* Hf	0.0282	±	0.0282	0.0011	±	0.0011
* Hg	0.0000	±	0.0158	0.0000	±	0.0006
Pb	0.0678	±	0.0158	0.0027	±	0.0006

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1812
Client ID: PS-OD-PM2.5-061912-01
Filter ID: P0458962
Sample Date: 6/19/12
Filter Lot #: 45155
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	3,198.	±	10.			
XRF						
* Na	0.0000	±	4.485	0.0000	±	0.1402
* Mg	3.906	±	1.411	0.1222	±	0.0441
Al	34.78	±	2.994	1.088	±	0.0937
Si	233.8	±	16.16	7.311	±	0.5058
P	0.2972	±	0.0531	0.0093	±	0.0017
S	0.1638	±	0.0362	0.0051	±	0.0011
Cl	0.2712	±	0.0542	0.0085	±	0.0017
K	12.52	±	0.6565	0.3915	±	0.0206
Ca	19.49	±	1.006	0.6095	±	0.0315
Ti	1.374	±	0.0791	0.0430	±	0.0025
* V	0.0237	±	0.0158	0.0007	±	0.0005
Cr	0.0339	±	0.0090	0.0011	±	0.0003
Mn	0.2588	±	0.0203	0.0081	±	0.0006
Fe	15.58	±	0.7865	0.4873	±	0.0246
* Co	0.0000	±	0.0136	0.0000	±	0.0004
* Ni	0.0000	±	0.0068	0.0000	±	0.0002
Cu	0.0463	±	0.0079	0.0014	±	0.0002
* Zn	0.0215	±	0.0079	0.0007	±	0.0002
* Ga	0.0034	±	0.0068	0.0001	±	0.0002
* Ge	0.0056	±	0.0056	0.0002	±	0.0002
* As	0.0000	±	0.0090	0.0000	±	0.0003
* Se	0.0124	±	0.0056	0.0004	±	0.0002
Br	0.0972	±	0.0079	0.0030	±	0.0002
Rb	0.0655	±	0.0068	0.0020	±	0.0002
Sr	0.1300	±	0.0102	0.0041	±	0.0003
* Y	0.0215	±	0.0079	0.0007	±	0.0002
Zr	0.0870	±	0.0113	0.0027	±	0.0004
* Mo	0.0000	±	0.0147	0.0000	±	0.0005
* Pd	0.0000	±	0.0305	0.0000	±	0.0010
* Ag	0.0000	±	0.0316	0.0000	±	0.0010
Cd	0.2768	±	0.0373	0.0087	±	0.0012
* In	0.0000	±	0.0339	0.0000	±	0.0011
* Sn	0.0000	±	0.0418	0.0000	±	0.0013
* Sb	0.0000	±	0.0486	0.0000	±	0.0015
Ba	0.2667	±	0.0610	0.0083	±	0.0019
* La	0.0407	±	0.0463	0.0013	±	0.0014
* Hf	0.0429	±	0.0260	0.0013	±	0.0008
* Hg	0.0000	±	0.0147	0.0000	±	0.0005
Pb	0.0565	±	0.0147	0.0018	±	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1814
Client ID: PS-OD-PM10-061812-01
Filter ID: P0458964
Sample Date: 6/18/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,741.	±	10.			
XRF						
* Na	0.0000	±	4.739	0.0000	±	0.1729
Mg	5.480	±	1.651	0.1999	±	0.0602
Al	38.52	±	3.269	1.405	±	0.1194
Si	302.2	±	20.59	11.02	±	0.7522
P	0.3808	±	0.0689	0.0139	±	0.0025
S	0.2170	±	0.0463	0.0079	±	0.0017
Cl	0.1955	±	0.0531	0.0071	±	0.0019
K	15.12	±	0.7899	0.5516	±	0.0289
Ca	24.35	±	1.254	0.8884	±	0.0459
Ti	1.570	±	0.0893	0.0573	±	0.0033
* V	0.0373	±	0.0170	0.0014	±	0.0006
Cr	0.0396	±	0.0102	0.0014	±	0.0004
Mn	0.3141	±	0.0226	0.0115	±	0.0008
Fe	14.48	±	0.7311	0.5281	±	0.0267
* Co	0.0000	±	0.0136	0.0000	±	0.0005
* Ni	0.0000	±	0.0068	0.0000	±	0.0002
Cu	0.0305	±	0.0068	0.0011	±	0.0002
Zn	0.0565	±	0.0090	0.0021	±	0.0003
* Ga	0.0170	±	0.0068	0.0006	±	0.0002
* Ge	0.0136	±	0.0068	0.0005	±	0.0002
* As	0.0023	±	0.0090	0.0001	±	0.0003
* Se	0.0136	±	0.0056	0.0005	±	0.0002
Br	0.0192	±	0.0045	0.0007	±	0.0002
Rb	0.0610	±	0.0068	0.0022	±	0.0002
Sr	0.1537	±	0.0113	0.0056	±	0.0004
* Y	0.0192	±	0.0079	0.0007	±	0.0003
Zr	0.1074	±	0.0124	0.0039	±	0.0005
* Mo	0.0068	±	0.0147	0.0002	±	0.0005
* Pd	0.0000	±	0.0305	0.0000	±	0.0011
* Ag	0.0000	±	0.0316	0.0000	±	0.0012
* Cd	0.0000	±	0.0328	0.0000	±	0.0012
* In	0.0000	±	0.0350	0.0000	±	0.0013
* Sn	0.0000	±	0.0429	0.0000	±	0.0016
* Sb	0.0000	±	0.0475	0.0000	±	0.0017
Ba	0.5221	±	0.0689	0.0190	±	0.0025
* La	0.0056	±	0.0531	0.0002	±	0.0019
* Hf	0.0147	±	0.0249	0.0005	±	0.0009
* Hg	0.0000	±	0.0147	0.0000	±	0.0005
Pb	0.0622	±	0.0147	0.0023	±	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1816
Client ID: PS-OD-PM10-062112-03
Filter ID: P0458966
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	3,443.	±	10.			
XRF						
* Na	0.0000	±	5.725	0.0000	±	0.1663
* Mg	4.944	±	1.745	0.1436	±	0.0507
Al	39.43	±	3.498	1.145	±	0.1017
Si	283.1	±	19.94	8.221	±	0.5798
P	0.3141	±	0.0689	0.0091	±	0.0020
* S	0.1740	±	0.0768	0.0051	±	0.0022
Cl	0.5062	±	0.0633	0.0147	±	0.0018
K	13.00	±	0.6825	0.3774	±	0.0199
Ca	21.36	±	1.104	0.6203	±	0.0321
Ti	1.350	±	0.0791	0.0392	±	0.0023
V	0.0610	±	0.0158	0.0018	±	0.0005
Cr	0.0452	±	0.0102	0.0013	±	0.0003
Mn	0.2791	±	0.0215	0.0081	±	0.0006
Fe	15.54	±	0.7842	0.4513	±	0.0228
* Co	0.0000	±	0.0136	0.0000	±	0.0004
* Ni	0.0000	±	0.0068	0.0000	±	0.0002
* Cu	0.0136	±	0.0068	0.0004	±	0.0002
Zn	0.0475	±	0.0079	0.0014	±	0.0002
Ga	0.0249	±	0.0068	0.0007	±	0.0002
* Ge	0.0000	±	0.0056	0.0000	±	0.0002
As	0.0305	±	0.0068	0.0009	±	0.0002
* Se	0.0000	±	0.0056	0.0000	±	0.0002
Br	0.0565	±	0.0056	0.0016	±	0.0002
Rb	0.0486	±	0.0068	0.0014	±	0.0002
Sr	0.1435	±	0.0102	0.0042	±	0.0003
Y	0.0305	±	0.0090	0.0009	±	0.0003
Zr	0.0904	±	0.0124	0.0026	±	0.0004
* Mo	0.0000	±	0.0147	0.0000	±	0.0004
* Pd	0.0000	±	0.0305	0.0000	±	0.0009
* Ag	0.0000	±	0.0316	0.0000	±	0.0009
Cd	0.2927	±	0.0384	0.0085	±	0.0011
* In	0.0644	±	0.0362	0.0019	±	0.0011
* Sn	0.0271	±	0.0429	0.0008	±	0.0012
* Sb	0.0000	±	0.0486	0.0000	±	0.0014
Ba	0.5040	±	0.0633	0.0146	±	0.0018
* La	0.0034	±	0.0599	0.0001	±	0.0017
* Hf	0.0170	±	0.0260	0.0005	±	0.0008
* Hg	0.0000	±	0.0124	0.0000	±	0.0004
* Pb	0.0068	±	0.0147	0.0002	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1817
Client ID: PS-OD-PM10-061912-01
Filter ID: P0458967
Sample Date: 6/19/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,332.	±	10.			
XRF						
* Na	7.750	±	4.757	0.3323	±	0.2040
Mg	4.587	±	1.414	0.1967	±	0.0606
Al	43.90	±	3.624	1.883	±	0.1556
Si	330.1	±	22.15	14.15	±	0.9517
P	0.3831	±	0.0701	0.0164	±	0.0030
S	0.2554	±	0.0836	0.0110	±	0.0036
Cl	0.5142	±	0.0655	0.0220	±	0.0028
K	16.94	±	0.8837	0.7264	±	0.0380
Ca	25.89	±	1.332	1.110	±	0.0573
Ti	1.794	±	0.1017	0.0769	±	0.0044
* V	0.0350	±	0.0192	0.0015	±	0.0008
Cr	0.0588	±	0.0113	0.0025	±	0.0005
Mn	0.3469	±	0.0249	0.0149	±	0.0011
Fe	19.70	±	0.9921	0.8446	±	0.0427
* Co	0.0000	±	0.0158	0.0000	±	0.0007
* Ni	0.0000	±	0.0068	0.0000	±	0.0003
Cu	0.0339	±	0.0079	0.0015	±	0.0003
Zn	0.0599	±	0.0090	0.0026	±	0.0004
* Ga	0.0045	±	0.0068	0.0002	±	0.0003
* Ge	0.0000	±	0.0068	0.0000	±	0.0003
* As	0.0000	±	0.0102	0.0000	±	0.0004
* Se	0.0124	±	0.0056	0.0005	±	0.0002
Br	0.1390	±	0.0102	0.0060	±	0.0004
Rb	0.0791	±	0.0079	0.0034	±	0.0003
Sr	0.1887	±	0.0124	0.0081	±	0.0005
* Y	0.0215	±	0.0090	0.0009	±	0.0004
Zr	0.1232	±	0.0136	0.0053	±	0.0006
* Mo	0.0000	±	0.0158	0.0000	±	0.0007
* Pd	0.0000	±	0.0328	0.0000	±	0.0014
* Ag	0.0000	±	0.0328	0.0000	±	0.0014
Cd	0.3108	±	0.0396	0.0133	±	0.0017
* In	0.0000	±	0.0362	0.0000	±	0.0016
* Sn	0.0000	±	0.0452	0.0000	±	0.0019
* Sb	0.0000	±	0.0508	0.0000	±	0.0022
Ba	0.8373	±	0.0757	0.0359	±	0.0033
* La	0.0463	±	0.0565	0.0020	±	0.0024
* Hf	0.0000	±	0.0282	0.0000	±	0.0012
* Hg	0.0124	±	0.0136	0.0005	±	0.0006
Pb	0.0633	±	0.0158	0.0027	±	0.0007

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1819
Client ID: PS-OD-PM2.5-062112-02-OR
Filter ID: P0458969
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	7,267.	±	10.			
XRF						
* Na	0.0000	±	20.44	0.0000	±	0.2813
* Mg	8.829	±	4.796	0.1215	±	0.0660
Al	72.73	±	8.439	1.001	±	0.1161
Si	575.5	±	50.52	7.919	±	0.6953
P	0.6283	±	0.1254	0.0086	±	0.0017
* S	0.2271	±	0.0780	0.0031	±	0.0011
Cl	0.4644	±	0.0848	0.0064	±	0.0012
K	24.28	±	1.307	0.3342	±	0.0180
Ca	33.76	±	1.783	0.4646	±	0.0245
Ti	2.518	±	0.1356	0.0346	±	0.0019
V	0.0734	±	0.0203	0.0010	±	0.0003
Cr	0.0644	±	0.0124	0.0009	±	0.0002
Mn	0.4735	±	0.0305	0.0065	±	0.0004
Fe	27.35	±	1.375	0.3763	±	0.0189
* Co	0.0000	±	0.0181	0.0000	±	0.0002
* Ni	0.0000	±	0.0079	0.0000	±	0.0001
Cu	0.0712	±	0.0090	0.0010	±	0.0001
Zn	0.0678	±	0.0090	0.0009	±	0.0001
* Ga	0.0226	±	0.0079	0.0003	±	0.0001
* Ge	0.0147	±	0.0068	0.0002	±	0.0001
* As	0.0068	±	0.0102	0.0001	±	0.0001
Se	0.0203	±	0.0056	0.0003	±	0.0001
Br	0.1333	±	0.0090	0.0018	±	0.0001
Rb	0.1028	±	0.0090	0.0014	±	0.0001
Sr	0.2407	±	0.0147	0.0033	±	0.0002
* Y	0.0056	±	0.0090	0.0001	±	0.0001
Zr	0.1831	±	0.0147	0.0025	±	0.0002
* Mo	0.0000	±	0.0158	0.0000	±	0.0002
* Pd	0.0181	±	0.0339	0.0002	±	0.0005
* Ag	0.0000	±	0.0339	0.0000	±	0.0005
Cd	0.4746	±	0.0463	0.0065	±	0.0006
* In	0.0000	±	0.0384	0.0000	±	0.0005
* Sn	0.0000	±	0.0452	0.0000	±	0.0006
* Sb	0.0000	±	0.0520	0.0000	±	0.0007
Ba	0.6644	±	0.0960	0.0091	±	0.0013
* La	0.0000	±	0.0836	0.0000	±	0.0012
* Hf	0.0068	±	0.0282	0.0001	±	0.0004
* Hg	0.0000	±	0.0158	0.0000	±	0.0002
Pb	0.0542	±	0.0147	0.0007	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1820
Client ID: PS-OD-PM2.5-062112-03
Filter ID: P0458970
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	4,499.	±	10.			
XRF						
* Na	0.0000	±	9.294	0.0000	±	0.2066
* Mg	6.461	±	2.589	0.1436	±	0.0575
Al	56.40	±	5.448	1.254	±	0.1211
Si	444.4	±	33.73	9.878	±	0.7501
P	0.6656	±	0.0994	0.0148	±	0.0022
* S	0.2859	±	0.1107	0.0064	±	0.0025
Cl	0.6272	±	0.0836	0.0139	±	0.0019
K	20.78	±	1.101	0.4619	±	0.0245
Ca	34.13	±	1.776	0.7585	±	0.0395
Ti	2.302	±	0.1254	0.0512	±	0.0028
* V	0.0497	±	0.0203	0.0011	±	0.0005
Cr	0.0520	±	0.0124	0.0012	±	0.0003
Mn	0.4509	±	0.0294	0.0100	±	0.0007
Fe	24.13	±	1.214	0.5362	±	0.0270
* Co	0.0000	±	0.0170	0.0000	±	0.0004
* Ni	0.0000	±	0.0068	0.0000	±	0.0002
Cu	0.0260	±	0.0079	0.0006	±	0.0002
Zn	0.0644	±	0.0102	0.0014	±	0.0002
Ga	0.0339	±	0.0079	0.0008	±	0.0002
* Ge	0.0192	±	0.0068	0.0004	±	0.0002
* As	0.0011	±	0.0113	0.0000	±	0.0003
* Se	0.0102	±	0.0056	0.0002	±	0.0001
Br	0.0712	±	0.0068	0.0016	±	0.0002
Rb	0.0859	±	0.0090	0.0019	±	0.0002
Sr	0.2418	±	0.0158	0.0054	±	0.0004
* Y	0.0294	±	0.0102	0.0007	±	0.0002
Zr	0.2034	±	0.0170	0.0045	±	0.0004
* Mo	0.0000	±	0.0170	0.0000	±	0.0004
* Pd	0.0000	±	0.0350	0.0000	±	0.0008
* Ag	0.0000	±	0.0350	0.0000	±	0.0008
Cd	0.4238	±	0.0452	0.0094	±	0.0010
* In	0.0000	±	0.0396	0.0000	±	0.0009
* Sn	0.0000	±	0.0475	0.0000	±	0.0011
* Sb	0.0000	±	0.0542	0.0000	±	0.0012
Ba	0.6904	±	0.0938	0.0153	±	0.0021
* La	0.1074	±	0.0712	0.0024	±	0.0016
* Hf	0.0000	±	0.0294	0.0000	±	0.0007
* Hg	0.0000	±	0.0170	0.0000	±	0.0004
Pb	0.0655	±	0.0170	0.0015	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1821
Client ID: BS-OD-PM2.5-062012
Filter ID: P0458971
Sample Date: 6/20/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	266.	±	10.			
XRF						
* Na	0.8113	±	0.8916	0.3050	±	0.3354
* Mg	0.4384	±	0.2497	0.1648	±	0.0941
Al	2.880	±	0.2520	1.083	±	0.1031
Si	15.94	±	0.9300	5.994	±	0.4159
* P	0.0124	±	0.0237	0.0047	±	0.0089
S	0.2158	±	0.0249	0.0811	±	0.0098
Cl	0.1526	±	0.0396	0.0573	±	0.0150
K	1.249	±	0.0746	0.4694	±	0.0331
Ca	1.907	±	0.1040	0.7171	±	0.0475
* Ti	0.0396	±	0.0339	0.0149	±	0.0128
* V	0.0000	±	0.0136	0.0000	±	0.0051
* Cr	0.0203	±	0.0079	0.0076	±	0.0030
* Mn	0.0260	±	0.0102	0.0098	±	0.0038
Fe	1.645	±	0.0893	0.6185	±	0.0408
* Co	0.0000	±	0.0068	0.0000	±	0.0025
* Ni	0.0000	±	0.0056	0.0000	±	0.0021
Cu	0.0203	±	0.0068	0.0076	±	0.0026
* Zn	0.0000	±	0.0068	0.0000	±	0.0025
* Ga	0.0102	±	0.0068	0.0038	±	0.0026
* Ge	0.0000	±	0.0068	0.0000	±	0.0025
* As	0.0000	±	0.0090	0.0000	±	0.0034
* Se	0.0079	±	0.0056	0.0030	±	0.0021
* Br	0.0068	±	0.0045	0.0025	±	0.0017
* Rb	0.0056	±	0.0056	0.0021	±	0.0021
* Sr	0.0090	±	0.0068	0.0034	±	0.0026
* Y	0.0011	±	0.0079	0.0004	±	0.0030
* Zr	0.0294	±	0.0102	0.0110	±	0.0038
* Mo	0.0000	±	0.0158	0.0000	±	0.0059
* Pd	0.0102	±	0.0294	0.0038	±	0.0110
* Ag	0.0000	±	0.0305	0.0000	±	0.0115
* Cd	0.0000	±	0.0294	0.0000	±	0.0110
* In	0.0000	±	0.0328	0.0000	±	0.0123
* Sn	0.0000	±	0.0407	0.0000	±	0.0153
* Sb	0.0000	±	0.0463	0.0000	±	0.0174
Ba	0.1277	±	0.0362	0.0480	±	0.0137
La	0.1390	±	0.0203	0.0523	±	0.0079
* Hf	0.0294	±	0.0260	0.0110	±	0.0098
* Hg	0.0237	±	0.0124	0.0089	±	0.0047
* Pb	0.0362	±	0.0147	0.0136	±	0.0055

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1822
Client ID: PS-OD-PM10-062112-02-OR
Filter ID: P0458972
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	4,144.	±	10.			
XRF						
* Na	0.0000	±	17.21	0.0000	±	0.4153
* Mg	9.251	±	4.438	0.2232	±	0.1071
Al	91.82	±	9.094	2.216	±	0.2195
Si	756.0	±	58.94	18.24	±	1.423
P	0.9978	±	0.1763	0.0241	±	0.0043
* S	0.4497	±	0.1537	0.0109	±	0.0037
Cl	0.9662	±	0.1198	0.0233	±	0.0029
K	34.84	±	1.859	0.8407	±	0.0449
Ca	48.16	±	2.529	1.162	±	0.0611
Ti	3.652	±	0.1944	0.0881	±	0.0047
V	0.1040	±	0.0271	0.0025	±	0.0007
Cr	0.1096	±	0.0170	0.0026	±	0.0004
Mn	0.7277	±	0.0429	0.0176	±	0.0010
Fe	39.55	±	1.984	0.9544	±	0.0479
* Co	0.0000	±	0.0215	0.0000	±	0.0005
* Ni	0.0000	±	0.0079	0.0000	±	0.0002
Cu	0.0802	±	0.0102	0.0019	±	0.0002
Zn	0.1074	±	0.0113	0.0026	±	0.0003
Ga	0.0350	±	0.0079	0.0008	±	0.0002
* Ge	0.0147	±	0.0079	0.0004	±	0.0002
* As	0.0147	±	0.0113	0.0004	±	0.0003
* Se	0.0000	±	0.0068	0.0000	±	0.0002
Br	0.2068	±	0.0124	0.0050	±	0.0003
Rb	0.1514	±	0.0113	0.0037	±	0.0003
Sr	0.3379	±	0.0192	0.0082	±	0.0005
* Y	0.0000	±	0.0102	0.0000	±	0.0002
Zr	0.2983	±	0.0203	0.0072	±	0.0005
* Mo	0.0000	±	0.0170	0.0000	±	0.0004
* Pd	0.0000	±	0.0373	0.0000	±	0.0009
* Ag	0.0000	±	0.0373	0.0000	±	0.0009
Cd	0.7797	±	0.0599	0.0188	±	0.0014
* In	0.0000	±	0.0407	0.0000	±	0.0010
* Sn	0.0000	±	0.0486	0.0000	±	0.0012
* Sb	0.0000	±	0.0588	0.0000	±	0.0014
Ba	1.663	±	0.1333	0.0401	±	0.0032
* La	0.1356	±	0.1164	0.0033	±	0.0028
* Hf	0.0000	±	0.0316	0.0000	±	0.0008
* Hg	0.0000	±	0.0170	0.0000	±	0.0004
* Pb	0.0418	±	0.0170	0.0010	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1823
Client ID: BS-OD-PM10-062012-01
Filter ID: P0458973
Sample Date: 6/20/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	197.	±	10.			
XRF						
* Na	0.0000	±	0.3401	0.0000	±	0.1727
* Mg	0.3910	±	0.2599	0.1985	±	0.1323
Al	3.922	±	0.3153	1.991	±	0.1893
Si	19.91	±	1.153	10.11	±	0.7782
* P	0.0000	±	0.0237	0.0000	±	0.0120
S	0.2497	±	0.0260	0.1268	±	0.0147
Cl	0.3062	±	0.0463	0.1554	±	0.0248
K	1.520	±	0.0881	0.7715	±	0.0595
Ca	2.182	±	0.1175	1.108	±	0.0820
Ti	0.1435	±	0.0350	0.0728	±	0.0182
* V	0.0000	±	0.0136	0.0000	±	0.0069
* Cr	0.0113	±	0.0079	0.0057	±	0.0040
Mn	0.0497	±	0.0102	0.0252	±	0.0053
Fe	1.810	±	0.0983	0.9189	±	0.0683
* Co	0.0000	±	0.0068	0.0000	±	0.0034
* Ni	0.0000	±	0.0056	0.0000	±	0.0029
* Cu	0.0068	±	0.0068	0.0034	±	0.0034
* Zn	0.0000	±	0.0079	0.0000	±	0.0040
* Ga	0.0045	±	0.0068	0.0023	±	0.0034
* Ge	0.0102	±	0.0068	0.0052	±	0.0035
* As	0.0000	±	0.0102	0.0000	±	0.0052
* Se	0.0090	±	0.0056	0.0046	±	0.0029
* Br	0.0079	±	0.0056	0.0040	±	0.0029
* Rb	0.0102	±	0.0056	0.0052	±	0.0029
Sr	0.0305	±	0.0068	0.0155	±	0.0035
Y	0.0316	±	0.0090	0.0161	±	0.0047
* Zr	0.0237	±	0.0113	0.0120	±	0.0058
* Mo	0.0000	±	0.0158	0.0000	±	0.0080
* Pd	0.0712	±	0.0305	0.0361	±	0.0156
* Ag	0.0000	±	0.0305	0.0000	±	0.0155
* Cd	0.0000	±	0.0294	0.0000	±	0.0149
* In	0.0000	±	0.0328	0.0000	±	0.0166
* Sn	0.0000	±	0.0418	0.0000	±	0.0212
* Sb	0.0000	±	0.0475	0.0000	±	0.0241
* Ba	0.0000	±	0.0373	0.0000	±	0.0189
* La	0.0441	±	0.0271	0.0224	±	0.0138
* Hf	0.0362	±	0.0271	0.0184	±	0.0138
* Hg	0.0000	±	0.0158	0.0000	±	0.0080
* Pb	0.0429	±	0.0147	0.0218	±	0.0075

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1824
Client ID: PS-OD-PM2.5-062312-01
Filter ID: P0458974
Sample Date: 6/23/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed
massive deposit loss prior to XRF

Analyte	µg/filter		percent	
Gravimetry				
Net Mass	16,310.	± 10.		
XRF				
* Na	0.0000	±101.4	0.0000	± 0.6215
* Mg	21.38	± 18.28	0.1311	± 0.1121
Al	146.2	± 27.93	0.8965	± 0.1713
Si	801.6	±105.2	4.915	± 0.6452
P	1.322	± 0.3062	0.0081	± 0.0019
S	0.5955	± 0.1627	0.0037	± 0.0010
* Cl	0.3187	± 0.1220	0.0020	± 0.0007
K	39.04	± 2.214	0.2394	± 0.0136
Ca	73.22	± 4.017	0.4490	± 0.0246
Ti	4.017	± 0.2136	0.0246	± 0.0013
* V	0.0362	± 0.0294	0.0002	± 0.0002
Cr	0.4916	± 0.0316	0.0030	± 0.0002
Mn	0.8294	± 0.0486	0.0051	± 0.0003
Fe	39.66	± 1.990	0.2432	± 0.0122
* Co	0.0000	± 0.0215	0.0000	± 0.0001
Ni	0.2113	± 0.0170	0.0013	± 0.0001
Cu	0.4023	± 0.0373	0.0025	± 0.0002
Zn	0.3797	± 0.0350	0.0023	± 0.0002
* Ga	0.0226	± 0.0090	0.0001	± 0.0001
* Ge	0.0000	± 0.0090	0.0000	± 0.0001
* As	0.0237	± 0.0124	0.0001	± 0.0001
* Se	0.0045	± 0.0068	0.0000	± 0.0000
Br	0.0486	± 0.0068	0.0003	± 0.0000
Rb	0.1785	± 0.0124	0.0011	± 0.0001
Sr	0.4384	± 0.0249	0.0027	± 0.0002
Y	0.0622	± 0.0102	0.0004	± 0.0001
Zr	0.2486	± 0.0181	0.0015	± 0.0001
* Mo	0.0000	± 0.0181	0.0000	± 0.0001
* Pd	0.0486	± 0.0350	0.0003	± 0.0002
* Ag	0.0000	± 0.0373	0.0000	± 0.0002
* Cd	0.0881	± 0.0373	0.0005	± 0.0002
* In	0.0000	± 0.0407	0.0000	± 0.0002
Sn	0.1819	± 0.0520	0.0011	± 0.0003
* Sb	0.0090	± 0.0554	0.0001	± 0.0003
Ba	1.721	± 0.1435	0.0106	± 0.0009
* La	0.0000	± 0.1074	0.0000	± 0.0007
* Hf	0.0000	± 0.0328	0.0000	± 0.0002
Hg	0.0520	± 0.0158	0.0003	± 0.0001
Pb	0.1503	± 0.0192	0.0009	± 0.0001

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1825
Client ID: PS-OD-PM2.5-062112-04-OR
Filter ID: P0458975
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,490.	±	10.			
XRF						
* Na	0.0000	±	2.861	0.0000	±	0.1149
Mg	2.781	±	0.8825	0.1117	±	0.0354
Al	24.84	±	2.036	0.9975	±	0.0819
Si	180.8	±	11.94	7.261	±	0.4806
P	0.1864	±	0.0418	0.0075	±	0.0017
S	0.1254	±	0.0305	0.0050	±	0.0012
* Cl	0.1243	±	0.0463	0.0050	±	0.0019
K	9.189	±	0.4814	0.3690	±	0.0194
Ca	14.59	±	0.7503	0.5859	±	0.0302
Ti	0.9413	±	0.0622	0.0378	±	0.0025
* V	0.0000	±	0.0158	0.0000	±	0.0006
* Cr	0.0260	±	0.0090	0.0010	±	0.0004
Mn	0.2271	±	0.0181	0.0091	±	0.0007
Fe	10.68	±	0.5413	0.4289	±	0.0218
* Co	0.0000	±	0.0113	0.0000	±	0.0005
* Ni	0.0000	±	0.0056	0.0000	±	0.0002
Cu	0.0226	±	0.0068	0.0009	±	0.0003
Zn	0.0260	±	0.0079	0.0010	±	0.0003
* Ga	0.0045	±	0.0068	0.0002	±	0.0003
* Ge	0.0079	±	0.0068	0.0003	±	0.0003
As	0.0215	±	0.0056	0.0009	±	0.0002
* Se	0.0158	±	0.0056	0.0006	±	0.0002
Br	0.0181	±	0.0045	0.0007	±	0.0002
Rb	0.0441	±	0.0068	0.0018	±	0.0003
Sr	0.1119	±	0.0090	0.0045	±	0.0004
* Y	0.0124	±	0.0090	0.0005	±	0.0004
Zr	0.0972	±	0.0113	0.0039	±	0.0005
* Mo	0.0000	±	0.0147	0.0000	±	0.0006
* Pd	0.0000	±	0.0305	0.0000	±	0.0012
* Ag	0.0000	±	0.0305	0.0000	±	0.0012
* Cd	0.0271	±	0.0328	0.0011	±	0.0013
* In	0.0000	±	0.0339	0.0000	±	0.0014
* Sn	0.0000	±	0.0418	0.0000	±	0.0017
* Sb	0.0000	±	0.0486	0.0000	±	0.0020
Ba	0.3966	±	0.0531	0.0159	±	0.0021
* La	0.0079	±	0.0407	0.0003	±	0.0016
* Hf	0.0000	±	0.0260	0.0000	±	0.0010
* Hg	0.0000	±	0.0147	0.0000	±	0.0006
* Pb	0.0068	±	0.0136	0.0003	±	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1827
Client ID: PS-OD-PM10-062112-04-OR
Filter ID: P0458977
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,961.	±	10.			
XRF						
* Na	0.0000	±	2.870	0.0000	±	0.1464
Mg	2.837	±	0.9108	0.1447	±	0.0465
Al	29.52	±	2.340	1.505	±	0.1196
Si	237.9	±	15.41	12.13	±	0.7884
P	0.2678	±	0.0486	0.0137	±	0.0025
S	0.1028	±	0.0328	0.0052	±	0.0017
Cl	0.2599	±	0.0508	0.0133	±	0.0026
K	11.75	±	0.6125	0.5993	±	0.0314
Ca	18.11	±	0.9300	0.9237	±	0.0477
Ti	1.114	±	0.0701	0.0568	±	0.0036
* V	0.0136	±	0.0158	0.0007	±	0.0008
* Cr	0.0237	±	0.0090	0.0012	±	0.0005
Mn	0.2430	±	0.0192	0.0124	±	0.0010
Fe	12.92	±	0.6531	0.6586	±	0.0335
* Co	0.0000	±	0.0124	0.0000	±	0.0006
* Ni	0.0000	±	0.0056	0.0000	±	0.0003
* Cu	0.0136	±	0.0068	0.0007	±	0.0003
Zn	0.0463	±	0.0079	0.0024	±	0.0004
Ga	0.0249	±	0.0068	0.0013	±	0.0003
* Ge	0.0045	±	0.0056	0.0002	±	0.0003
As	0.0271	±	0.0056	0.0014	±	0.0003
* Se	0.0068	±	0.0056	0.0003	±	0.0003
* Br	0.0068	±	0.0045	0.0003	±	0.0002
Rb	0.0497	±	0.0068	0.0025	±	0.0003
Sr	0.1119	±	0.0090	0.0057	±	0.0005
* Y	0.0056	±	0.0079	0.0003	±	0.0004
Zr	0.0848	±	0.0113	0.0043	±	0.0006
* Mo	0.0000	±	0.0147	0.0000	±	0.0007
* Pd	0.0068	±	0.0305	0.0003	±	0.0016
* Ag	0.0000	±	0.0316	0.0000	±	0.0016
* Cd	0.0825	±	0.0339	0.0042	±	0.0017
* In	0.0034	±	0.0339	0.0002	±	0.0017
* Sn	0.0000	±	0.0418	0.0000	±	0.0021
* Sb	0.0000	±	0.0452	0.0000	±	0.0023
Ba	0.6238	±	0.0588	0.0318	±	0.0030
* La	0.0429	±	0.0441	0.0022	±	0.0022
* Hf	0.0000	±	0.0249	0.0000	±	0.0013
* Hg	0.0000	±	0.0136	0.0000	±	0.0007
* Pb	0.0192	±	0.0136	0.0010	±	0.0007

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1828
Client ID: PS-OD-PM2.5-062212-01-W1
Filter ID: P0458978
Sample Date: 6/22/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	982.	±	10.			
XRF						
* Na	1.092	±	1.128	0.1112	±	0.1148
Mg	1.023	±	0.3164	0.1041	±	0.0322
Al	5.563	±	0.4497	0.5665	±	0.0462
Si	45.97	±	2.756	4.681	±	0.2847
* P	0.0000	±	0.0260	0.0000	±	0.0026
S	0.0655	±	0.0215	0.0067	±	0.0022
* Cl	0.0576	±	0.0373	0.0059	±	0.0038
K	2.359	±	0.1300	0.2403	±	0.0135
Ca	3.561	±	0.1876	0.3626	±	0.0195
Ti	0.1752	±	0.0350	0.0178	±	0.0036
* V	0.0000	±	0.0136	0.0000	±	0.0014
Cr	0.0576	±	0.0090	0.0059	±	0.0009
Mn	0.0486	±	0.0113	0.0049	±	0.0012
Fe	2.935	±	0.1537	0.2988	±	0.0159
* Co	0.0000	±	0.0079	0.0000	±	0.0008
* Ni	0.0045	±	0.0068	0.0005	±	0.0007
Cu	0.0362	±	0.0068	0.0037	±	0.0007
* Zn	0.0124	±	0.0079	0.0013	±	0.0008
* Ga	0.0136	±	0.0068	0.0014	±	0.0007
* Ge	0.0102	±	0.0056	0.0010	±	0.0006
* As	0.0000	±	0.0090	0.0000	±	0.0009
* Se	0.0113	±	0.0056	0.0012	±	0.0006
* Br	0.0090	±	0.0045	0.0009	±	0.0005
* Rb	0.0147	±	0.0056	0.0015	±	0.0006
* Sr	0.0181	±	0.0068	0.0018	±	0.0007
* Y	0.0136	±	0.0090	0.0014	±	0.0009
* Zr	0.0079	±	0.0102	0.0008	±	0.0010
* Mo	0.0045	±	0.0147	0.0005	±	0.0015
* Pd	0.0068	±	0.0305	0.0007	±	0.0031
* Ag	0.0000	±	0.0294	0.0000	±	0.0030
* Cd	0.0282	±	0.0305	0.0029	±	0.0031
* In	0.0000	±	0.0328	0.0000	±	0.0033
* Sn	0.0000	±	0.0407	0.0000	±	0.0041
* Sb	0.0147	±	0.0452	0.0015	±	0.0046
Ba	0.1367	±	0.0384	0.0139	±	0.0039
* La	0.0712	±	0.0282	0.0072	±	0.0029
* Hf	0.0768	±	0.0260	0.0078	±	0.0026
* Hg	0.0000	±	0.0147	0.0000	±	0.0015
* Pb	0.0328	±	0.0147	0.0033	±	0.0015

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1829
Client ID: PS-OD-PM10-062212-01-W1
Filter ID: P0458979
Sample Date: 6/22/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed
NUDD

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	4,023.	±	10.			
XRF						
* Na	0.0000	±	8.720	0.0000	±	0.2168
* Mg	4.682	±	2.235	0.1164	±	0.0556
Al	51.82	±	4.824	1.288	±	0.1200
Si	384.7	±	28.33	9.561	±	0.7046
P	0.5514	±	0.0881	0.0137	±	0.0022
S	0.3944	±	0.0622	0.0098	±	0.0015
* Cl	0.1277	±	0.0588	0.0032	±	0.0015
K	18.92	±	0.9967	0.4702	±	0.0248
Ca	33.08	±	2.460	0.8222	±	0.0612
Ti	2.072	±	0.1130	0.0515	±	0.0028
V	0.0655	±	0.0181	0.0016	±	0.0004
Cr	0.7390	±	0.0610	0.0184	±	0.0015
Mn	0.5062	±	0.0328	0.0126	±	0.0008
Fe	25.23	±	1.269	0.6272	±	0.0316
* Co	0.0000	±	0.0170	0.0000	±	0.0004
Ni	0.3006	±	0.0203	0.0075	±	0.0005
Cu	0.4893	±	0.0282	0.0122	±	0.0007
Zn	0.3819	±	0.0237	0.0095	±	0.0006
* Ga	0.0124	±	0.0079	0.0003	±	0.0002
* Ge	0.0192	±	0.0068	0.0005	±	0.0002
* As	0.0000	±	0.0113	0.0000	±	0.0003
* Se	0.0000	±	0.0056	0.0000	±	0.0001
Br	0.0181	±	0.0056	0.0004	±	0.0001
Rb	0.0836	±	0.0079	0.0021	±	0.0002
Sr	0.1910	±	0.0124	0.0047	±	0.0003
* Y	0.0249	±	0.0090	0.0006	±	0.0002
Zr	0.0791	±	0.0124	0.0020	±	0.0003
* Mo	0.0328	±	0.0158	0.0008	±	0.0004
* Pd	0.0678	±	0.0328	0.0017	±	0.0008
* Ag	0.0000	±	0.0328	0.0000	±	0.0008
* Cd	0.0000	±	0.0339	0.0000	±	0.0008
* In	0.0000	±	0.0373	0.0000	±	0.0009
* Sn	0.0927	±	0.0475	0.0023	±	0.0012
* Sb	0.0000	±	0.0497	0.0000	±	0.0012
* Ba	0.1876	±	0.0814	0.0047	±	0.0020
* La	0.0000	±	0.0734	0.0000	±	0.0018
* Hf	0.0023	±	0.0294	0.0001	±	0.0007
* Hg	0.0000	±	0.0158	0.0000	±	0.0004
Pb	0.1514	±	0.0181	0.0038	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1830
Client ID: PS-OD-PM10-062312-02-OR
Filter ID: P0458980
Sample Date: 6/23/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed
NUDD

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	10,485.	±	10.			
XRF						
* Na	0.0000	±	99.67	0.0000	±	0.9506
* Mg	32.76	±	22.84	0.3124	±	0.2178
Al	234.5	±	36.19	2.236	±	0.3452
Si	1527.	±	172.4	14.56	±	1.645
P	3.193	±	0.5085	0.0305	±	0.0048
* S	0.6046	±	0.2441	0.0058	±	0.0023
Cl	0.9322	±	0.2576	0.0089	±	0.0025
K	101.6	±	5.745	0.9691	±	0.0548
Ca	190.5	±	10.47	1.817	±	0.0999
Ti	11.47	±	0.5921	0.1094	±	0.0056
V	0.4339	±	0.0655	0.0041	±	0.0006
Cr	1.722	±	0.0972	0.0164	±	0.0009
Mn	2.209	±	0.1175	0.0211	±	0.0011
Fe	117.2	±	8.272	1.118	±	0.0789
* Co	0.0000	±	0.0362	0.0000	±	0.0003
Ni	0.6057	±	0.0373	0.0058	±	0.0004
Cu	1.286	±	0.1006	0.0123	±	0.0010
Zn	0.9628	±	0.0768	0.0092	±	0.0007
Ga	0.0429	±	0.0136	0.0004	±	0.0001
Ge	0.0734	±	0.0124	0.0007	±	0.0001
As	0.0780	±	0.0192	0.0007	±	0.0002
* Se	0.0068	±	0.0090	0.0001	±	0.0001
Br	0.1096	±	0.0113	0.0010	±	0.0001
Rb	0.5209	±	0.0294	0.0050	±	0.0003
Sr	1.284	±	0.0667	0.0122	±	0.0006
Y	0.1062	±	0.0158	0.0010	±	0.0002
Zr	0.6836	±	0.0396	0.0065	±	0.0004
* Mo	0.0000	±	0.0249	0.0000	±	0.0002
* Pd	0.0158	±	0.0452	0.0002	±	0.0004
* Ag	0.0000	±	0.0452	0.0000	±	0.0004
* Cd	0.0000	±	0.0452	0.0000	±	0.0004
* In	0.0000	±	0.0497	0.0000	±	0.0005
Sn	0.4226	±	0.0678	0.0040	±	0.0006
* Sb	0.0418	±	0.0644	0.0004	±	0.0006
Ba	4.480	±	0.3345	0.0427	±	0.0032
* La	0.0000	±	0.3096	0.0000	±	0.0030
* Hf	0.0000	±	0.0531	0.0000	±	0.0005
* Hg	0.0181	±	0.0294	0.0002	±	0.0003
Pb	0.3537	±	0.0328	0.0034	±	0.0003

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1831
Client ID: PS-OD-PM2.5-062312-02-OR
Filter ID: P0458981
Sample Date: 6/23/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed
massive deposit loss

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	9,146.	±	10.			
XRF						
* Na	0.0000	±	40.79	0.0000	±	0.4460
* Mg	17.66	±	9.363	0.1931	±	0.1024
Al	124.9	±	16.64	1.365	±	0.1820
Si	765.2	±	75.25	8.367	±	0.8228
P	1.679	±	0.2520	0.0184	±	0.0028
S	0.5921	±	0.1356	0.0065	±	0.0015
* Cl	0.2904	±	0.1232	0.0032	±	0.0013
K	48.41	±	2.648	0.5293	±	0.0290
Ca	89.96	±	4.809	0.9836	±	0.0526
Ti	5.464	±	0.2848	0.0597	±	0.0031
V	0.1186	±	0.0339	0.0013	±	0.0004
Cr	0.8249	±	0.0475	0.0090	±	0.0005
Mn	1.079	±	0.0610	0.0118	±	0.0007
Fe	56.68	±	4.532	0.6197	±	0.0496
* Co	0.0000	±	0.0249	0.0000	±	0.0003
Ni	0.2961	±	0.0203	0.0032	±	0.0002
Cu	0.5910	±	0.0497	0.0065	±	0.0005
Zn	0.4882	±	0.0429	0.0053	±	0.0005
* Ga	0.0068	±	0.0090	0.0001	±	0.0001
* Ge	0.0226	±	0.0079	0.0002	±	0.0001
* As	0.0260	±	0.0124	0.0003	±	0.0001
* Se	0.0124	±	0.0068	0.0001	±	0.0001
Br	0.0463	±	0.0068	0.0005	±	0.0001
Rb	0.2463	±	0.0147	0.0027	±	0.0002
Sr	0.5989	±	0.0316	0.0065	±	0.0003
Y	0.0316	±	0.0102	0.0003	±	0.0001
Zr	0.3141	±	0.0203	0.0034	±	0.0002
* Mo	0.0237	±	0.0170	0.0003	±	0.0002
* Pd	0.0034	±	0.0362	0.0000	±	0.0004
* Ag	0.0000	±	0.0373	0.0000	±	0.0004
* Cd	0.0136	±	0.0384	0.0001	±	0.0004
* In	0.0000	±	0.0407	0.0000	±	0.0004
Sn	0.2961	±	0.0554	0.0032	±	0.0006
* Sb	0.0011	±	0.0542	0.0000	±	0.0006
Ba	2.318	±	0.1842	0.0253	±	0.0020
* La	0.0000	±	0.1537	0.0000	±	0.0017
* Hf	0.0000	±	0.0350	0.0000	±	0.0004
* Hg	0.0000	±	0.0192	0.0000	±	0.0002
Pb	0.1729	±	0.0203	0.0019	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1832
Client ID: PS-OD-PM2.5-062512-03
Filter ID: P0458982
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,520.	±	10.			
XRF						
* Na	0.0000	±	2.620	0.0000	±	0.1040
Mg	3.721	±	0.9085	0.1477	±	0.0361
Al	26.40	±	2.164	1.047	±	0.0860
Si	179.8	±	11.90	7.134	±	0.4730
P	0.2011	±	0.0452	0.0080	±	0.0018
S	0.1051	±	0.0305	0.0042	±	0.0012
* Cl	0.0000	±	0.0441	0.0000	±	0.0017
K	10.27	±	0.5368	0.4074	±	0.0214
Ca	18.28	±	0.9390	0.7255	±	0.0374
Ti	1.137	±	0.0689	0.0451	±	0.0027
* V	0.0362	±	0.0158	0.0014	±	0.0006
Cr	0.0689	±	0.0102	0.0027	±	0.0004
Mn	0.2373	±	0.0192	0.0094	±	0.0008
Fe	11.56	±	0.5853	0.4587	±	0.0233
* Co	0.0000	±	0.0124	0.0000	±	0.0005
* Ni	0.0000	±	0.0068	0.0000	±	0.0003
Cu	0.0497	±	0.0079	0.0020	±	0.0003
Zn	0.0565	±	0.0090	0.0022	±	0.0004
* Ga	0.0124	±	0.0068	0.0005	±	0.0003
* Ge	0.0045	±	0.0068	0.0002	±	0.0003
As	0.0215	±	0.0056	0.0009	±	0.0002
* Se	0.0079	±	0.0056	0.0003	±	0.0002
* Br	0.0023	±	0.0045	0.0001	±	0.0002
Rb	0.0576	±	0.0068	0.0023	±	0.0003
Sr	0.1017	±	0.0090	0.0040	±	0.0004
Y	0.0305	±	0.0090	0.0012	±	0.0004
Zr	0.0757	±	0.0113	0.0030	±	0.0004
* Mo	0.0000	±	0.0158	0.0000	±	0.0006
* Pd	0.0000	±	0.0305	0.0000	±	0.0012
* Ag	0.0000	±	0.0305	0.0000	±	0.0012
* Cd	0.0000	±	0.0328	0.0000	±	0.0013
* In	0.0396	±	0.0350	0.0016	±	0.0014
* Sn	0.0000	±	0.0429	0.0000	±	0.0017
* Sb	0.0000	±	0.0475	0.0000	±	0.0019
Ba	0.3639	±	0.0588	0.0144	±	0.0023
* La	0.0000	±	0.0452	0.0000	±	0.0018
* Hf	0.0113	±	0.0271	0.0004	±	0.0011
* Hg	0.0000	±	0.0147	0.0000	±	0.0006
* Pb	0.0237	±	0.0147	0.0009	±	0.0006

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1833
Client ID: PS-OD-PM2.5-062512-01
Filter ID: P0458983
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed
NUDD

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	4,589.	±	10.			
XRF						
* Na	0.0000	±	10.07	0.0000	±	0.2194
* Mg	10.88	±	3.686	0.2372	±	0.0803
Al	78.08	±	7.588	1.702	±	0.1654
Si	451.0	±	34.68	9.827	±	0.7560
P	0.8927	±	0.1130	0.0195	±	0.0025
S	0.2870	±	0.0667	0.0063	±	0.0015
* Cl	0.2283	±	0.0814	0.0050	±	0.0018
K	33.35	±	1.763	0.7267	±	0.0384
Ca	67.49	±	5.006	1.471	±	0.1091
Ti	3.781	±	0.1989	0.0824	±	0.0043
V	0.0836	±	0.0260	0.0018	±	0.0006
Cr	0.4554	±	0.0282	0.0099	±	0.0006
Mn	0.9729	±	0.0554	0.0212	±	0.0012
Fe	42.56	±	2.135	0.9273	±	0.0466
* Co	0.0000	±	0.0226	0.0000	±	0.0005
Ni	0.1695	±	0.0147	0.0037	±	0.0003
Cu	0.3786	±	0.0339	0.0082	±	0.0007
Zn	0.3672	±	0.0226	0.0080	±	0.0005
* Ga	0.0181	±	0.0079	0.0004	±	0.0002
* Ge	0.0090	±	0.0068	0.0002	±	0.0001
* As	0.0260	±	0.0113	0.0006	±	0.0002
* Se	0.0034	±	0.0056	0.0001	±	0.0001
Br	0.0282	±	0.0056	0.0006	±	0.0001
Rb	0.1593	±	0.0113	0.0035	±	0.0002
Sr	0.3526	±	0.0203	0.0077	±	0.0004
Y	0.0373	±	0.0090	0.0008	±	0.0002
Zr	0.1582	±	0.0147	0.0034	±	0.0003
* Mo	0.0000	±	0.0158	0.0000	±	0.0003
* Pd	0.0000	±	0.0339	0.0000	±	0.0007
* Ag	0.0113	±	0.0350	0.0002	±	0.0008
* Cd	0.0000	±	0.0350	0.0000	±	0.0008
* In	0.0000	±	0.0384	0.0000	±	0.0008
* Sn	0.0000	±	0.0475	0.0000	±	0.0010
* Sb	0.0000	±	0.0508	0.0000	±	0.0011
Ba	1.575	±	0.1322	0.0343	±	0.0029
* La	0.0000	±	0.1107	0.0000	±	0.0024
* Hf	0.0000	±	0.0282	0.0000	±	0.0006
* Hg	0.0000	±	0.0158	0.0000	±	0.0003
Pb	0.1074	±	0.0170	0.0023	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1834
Client ID: PS-OD-PM2.5-062512-04-OR
Filter ID: P0458984
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,735.	±	10.			
XRF						
* Na	0.0000	±	1.686	0.0000	±	0.0972
* Mg	1.392	±	0.4723	0.0802	±	0.0272
Al	10.35	±	0.8283	0.5967	±	0.0479
Si	70.47	±	4.407	4.061	±	0.2551
* P	0.0282	±	0.0305	0.0016	±	0.0018
* S	0.0000	±	0.0226	0.0000	±	0.0013
* Cl	0.0000	±	0.0384	0.0000	±	0.0022
K	4.390	±	0.2339	0.2530	±	0.0136
Ca	7.363	±	0.3808	0.4244	±	0.0221
Ti	0.4712	±	0.0418	0.0272	±	0.0024
* V	0.0034	±	0.0136	0.0002	±	0.0008
Cr	0.0271	±	0.0090	0.0016	±	0.0005
Mn	0.1085	±	0.0124	0.0063	±	0.0007
Fe	5.025	±	0.2588	0.2896	±	0.0150
* Co	0.0000	±	0.0090	0.0000	±	0.0005
* Ni	0.0000	±	0.0056	0.0000	±	0.0003
* Cu	0.0079	±	0.0068	0.0005	±	0.0004
Zn	0.0260	±	0.0079	0.0015	±	0.0005
* Ga	0.0056	±	0.0068	0.0003	±	0.0004
* Ge	0.0000	±	0.0068	0.0000	±	0.0004
* As	0.0000	±	0.0090	0.0000	±	0.0005
* Se	0.0147	±	0.0056	0.0008	±	0.0003
* Br	0.0068	±	0.0045	0.0004	±	0.0003
Rb	0.0237	±	0.0056	0.0014	±	0.0003
Sr	0.0339	±	0.0068	0.0020	±	0.0004
* Y	0.0215	±	0.0079	0.0012	±	0.0005
* Zr	0.0237	±	0.0102	0.0014	±	0.0006
* Mo	0.0136	±	0.0147	0.0008	±	0.0008
* Pd	0.0203	±	0.0294	0.0012	±	0.0017
* Ag	0.0000	±	0.0305	0.0000	±	0.0018
* Cd	0.0000	±	0.0305	0.0000	±	0.0018
* In	0.0000	±	0.0339	0.0000	±	0.0020
* Sn	0.0000	±	0.0418	0.0000	±	0.0024
* Sb	0.0000	±	0.0463	0.0000	±	0.0027
Ba	0.1898	±	0.0429	0.0109	±	0.0025
* La	0.0000	±	0.0350	0.0000	±	0.0020
* Hf	0.0384	±	0.0260	0.0022	±	0.0015
* Hg	0.0192	±	0.0124	0.0011	±	0.0007
* Pb	0.0328	±	0.0136	0.0019	±	0.0008

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1835
Client ID: PS-OD-PM10-062312-01
Filter ID: P0458985
Sample Date: 6/23/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed
massive deposit loss

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	9,505.	±	10.			
XRF						
* Na	36.63	±	50.96	0.3854	±	0.5362
* Mg	24.01	±	10.72	0.2526	±	0.1128
Al	126.9	±	17.38	1.335	±	0.1828
Si	820.0	±	82.33	8.627	±	0.8662
P	1.648	±	0.2644	0.0173	±	0.0028
S	0.6249	±	0.1401	0.0066	±	0.0015
Cl	0.4927	±	0.1345	0.0052	±	0.0014
K	50.97	±	2.798	0.5363	±	0.0294
Ca	92.40	±	4.954	0.9721	±	0.0521
Ti	5.652	±	0.2949	0.0595	±	0.0031
V	0.2441	±	0.0373	0.0026	±	0.0004
Cr	1.040	±	0.0588	0.0109	±	0.0006
Mn	1.223	±	0.0678	0.0129	±	0.0007
Fe	61.31	±	3.159	0.6451	±	0.0332
* Co	0.0000	±	0.0260	0.0000	±	0.0003
Ni	0.4339	±	0.0271	0.0046	±	0.0003
Cu	0.7707	±	0.0622	0.0081	±	0.0007
Zn	0.5469	±	0.0463	0.0058	±	0.0005
* Ga	0.0124	±	0.0090	0.0001	±	0.0001
Ge	0.0282	±	0.0079	0.0003	±	0.0001
* As	0.0362	±	0.0124	0.0004	±	0.0001
* Se	0.0068	±	0.0068	0.0001	±	0.0001
Br	0.0497	±	0.0068	0.0005	±	0.0001
Rb	0.2531	±	0.0158	0.0027	±	0.0002
Sr	0.6407	±	0.0339	0.0067	±	0.0004
Y	0.0429	±	0.0102	0.0005	±	0.0001
Zr	0.3672	±	0.0226	0.0039	±	0.0002
* Mo	0.0000	±	0.0170	0.0000	±	0.0002
* Pd	0.0000	±	0.0373	0.0000	±	0.0004
* Ag	0.0000	±	0.0384	0.0000	±	0.0004
* Cd	0.0136	±	0.0373	0.0001	±	0.0004
* In	0.0000	±	0.0407	0.0000	±	0.0004
Sn	0.2927	±	0.0554	0.0031	±	0.0006
* Sb	0.0441	±	0.0554	0.0005	±	0.0006
Ba	2.424	±	0.1966	0.0255	±	0.0021
* La	0.0000	±	0.1661	0.0000	±	0.0017
* Hf	0.0000	±	0.0339	0.0000	±	0.0004
* Hg	0.0011	±	0.0181	0.0000	±	0.0002
Pb	0.2090	±	0.0215	0.0022	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1836
Client ID: PS-OD-PM2.5-062512-02-OR
Filter ID: P0458986
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	5,683.	±	10.			
XRF						
* Na	0.0000	±	18.67	0.0000	±	0.3285
* Mg	13.65	±	5.198	0.2402	±	0.0915
Al	108.9	±	11.63	1.917	±	0.2046
Si	595.7	±	49.22	10.48	±	0.8663
P	1.176	±	0.1785	0.0207	±	0.0031
* S	0.2882	±	0.1017	0.0051	±	0.0018
* Cl	0.1322	±	0.0870	0.0023	±	0.0015
K	36.40	±	1.946	0.6405	±	0.0343
Ca	67.78	±	3.560	1.193	±	0.0627
Ti	4.162	±	0.2181	0.0732	±	0.0038
V	0.1107	±	0.0271	0.0019	±	0.0005
Cr	0.5096	±	0.0316	0.0090	±	0.0006
Mn	1.017	±	0.0576	0.0179	±	0.0010
Fe	44.60	±	2.237	0.7848	±	0.0394
* Co	0.0000	±	0.0226	0.0000	±	0.0004
Ni	0.1944	±	0.0158	0.0034	±	0.0003
Cu	0.3526	±	0.0215	0.0062	±	0.0004
Zn	0.3028	±	0.0192	0.0053	±	0.0003
Ga	0.0294	±	0.0079	0.0005	±	0.0001
* Ge	0.0181	±	0.0068	0.0003	±	0.0001
* As	0.0170	±	0.0113	0.0003	±	0.0002
* Se	0.0034	±	0.0056	0.0001	±	0.0001
Br	0.0271	±	0.0056	0.0005	±	0.0001
Rb	0.1910	±	0.0124	0.0034	±	0.0002
Sr	0.4181	±	0.0237	0.0074	±	0.0004
* Y	0.0260	±	0.0090	0.0005	±	0.0002
Zr	0.2136	±	0.0158	0.0038	±	0.0003
* Mo	0.0068	±	0.0158	0.0001	±	0.0003
* Pd	0.0000	±	0.0362	0.0000	±	0.0006
* Ag	0.0000	±	0.0362	0.0000	±	0.0006
* Cd	0.0000	±	0.0362	0.0000	±	0.0006
* In	0.0102	±	0.0396	0.0002	±	0.0007
* Sn	0.1367	±	0.0497	0.0024	±	0.0009
* Sb	0.0000	±	0.0520	0.0000	±	0.0009
Ba	1.564	±	0.1435	0.0275	±	0.0025
* La	0.0000	±	0.1198	0.0000	±	0.0021
* Hf	0.0000	±	0.0305	0.0000	±	0.0005
* Hg	0.0000	±	0.0170	0.0000	±	0.0003
Pb	0.1254	±	0.0181	0.0022	±	0.0003

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1837
Client ID: PS-OD-PM10-062512-01
Filter ID: P0458987
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed
NUDD

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	9,544.	±	10.			
XRF						
* Na	0.0000	±	95.21	0.0000	±	0.9976
* Mg	42.91	±	27.07	0.4496	±	0.2837
Al	267.8	±	39.60	2.806	±	0.4149
Si	1523.	±	167.1	15.96	±	1.751
P	3.712	±	0.5424	0.0389	±	0.0057
S	1.144	±	0.2610	0.0120	±	0.0027
Cl	1.237	±	0.2757	0.0130	±	0.0029
K	118.5	±	6.681	1.242	±	0.0700
Ca	219.3	±	12.03	2.298	±	0.1261
Ti	13.37	±	0.6870	0.1401	±	0.0072
V	0.5492	±	0.0723	0.0058	±	0.0008
Cr	1.504	±	0.0881	0.0158	±	0.0009
Mn	3.009	±	0.1571	0.0315	±	0.0016
Fe	134.4	±	6.727	1.408	±	0.0705
* Co	0.0000	±	0.0418	0.0000	±	0.0004
Ni	0.4757	±	0.0328	0.0050	±	0.0003
Cu	1.234	±	0.0972	0.0129	±	0.0010
Zn	1.085	±	0.0859	0.0114	±	0.0009
Ga	0.0802	±	0.0147	0.0008	±	0.0002
* Ge	0.0136	±	0.0147	0.0001	±	0.0002
As	0.0915	±	0.0203	0.0010	±	0.0002
* Se	0.0203	±	0.0090	0.0002	±	0.0001
Br	0.1141	±	0.0113	0.0012	±	0.0001
Rb	0.6294	±	0.0339	0.0066	±	0.0004
Sr	1.471	±	0.0757	0.0154	±	0.0008
Y	0.1232	±	0.0158	0.0013	±	0.0002
Zr	0.7774	±	0.0441	0.0081	±	0.0005
* Mo	0.0000	±	0.0249	0.0000	±	0.0003
* Pd	0.0000	±	0.0452	0.0000	±	0.0005
* Ag	0.0000	±	0.0463	0.0000	±	0.0005
* Cd	0.0203	±	0.0463	0.0002	±	0.0005
* In	0.0000	±	0.0508	0.0000	±	0.0005
Sn	0.4633	±	0.0689	0.0049	±	0.0007
* Sb	0.0000	±	0.0655	0.0000	±	0.0007
Ba	4.969	±	0.3514	0.0521	±	0.0037
* La	0.0000	±	0.3492	0.0000	±	0.0037
* Hf	0.0000	±	0.0531	0.0000	±	0.0006
* Hg	0.0000	±	0.0316	0.0000	±	0.0003
Pb	0.4192	±	0.0350	0.0044	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1840
Client ID: PS-OD-PM10-062512-04-OR
Filter ID: P0458990
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,602.	±	10.			
XRF						
* Na	4.162	±	2.294	0.2598	±	0.1432
Mg	2.478	±	0.7322	0.1547	±	0.0457
Al	22.32	±	1.715	1.393	±	0.1074
Si	152.8	±	9.596	9.537	±	0.6020
P	0.1989	±	0.0396	0.0124	±	0.0025
* S	0.0531	±	0.0282	0.0033	±	0.0018
* Cl	0.0102	±	0.0429	0.0006	±	0.0027
K	8.538	±	0.4452	0.5330	±	0.0280
Ca	15.20	±	0.7786	0.9487	±	0.0490
Ti	0.9413	±	0.0610	0.0588	±	0.0038
* V	0.0407	±	0.0158	0.0025	±	0.0010
Cr	0.0814	±	0.0102	0.0051	±	0.0006
Mn	0.2215	±	0.0181	0.0138	±	0.0011
Fe	9.626	±	0.4882	0.6009	±	0.0307
* Co	0.0000	±	0.0113	0.0000	±	0.0007
* Ni	0.0000	±	0.0068	0.0000	±	0.0004
Cu	0.0542	±	0.0079	0.0034	±	0.0005
Zn	0.0497	±	0.0090	0.0031	±	0.0006
* Ga	0.0034	±	0.0068	0.0002	±	0.0004
* Ge	0.0023	±	0.0068	0.0001	±	0.0004
* As	0.0000	±	0.0090	0.0000	±	0.0006
* Se	0.0102	±	0.0056	0.0006	±	0.0004
* Br	0.0124	±	0.0045	0.0008	±	0.0003
Rb	0.0463	±	0.0068	0.0029	±	0.0004
Sr	0.0904	±	0.0090	0.0056	±	0.0006
Y	0.0271	±	0.0090	0.0017	±	0.0006
* Zr	0.0271	±	0.0113	0.0017	±	0.0007
* Mo	0.0192	±	0.0147	0.0012	±	0.0009
* Pd	0.0000	±	0.0316	0.0000	±	0.0020
* Ag	0.0000	±	0.0316	0.0000	±	0.0020
* Cd	0.0000	±	0.0305	0.0000	±	0.0019
* In	0.0260	±	0.0339	0.0016	±	0.0021
* Sn	0.0000	±	0.0418	0.0000	±	0.0026
* Sb	0.0000	±	0.0475	0.0000	±	0.0030
Ba	0.4588	±	0.0542	0.0286	±	0.0034
* La	0.0000	±	0.0520	0.0000	±	0.0032
* Hf	0.0000	±	0.0260	0.0000	±	0.0016
* Hg	0.0000	±	0.0147	0.0000	±	0.0009
Pb	0.0565	±	0.0147	0.0035	±	0.0009

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1841
Client ID: PS-OD-PM10-062512-02-OR
Filter ID: P0458991
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	7,857.	±	10.			
XRF						
* Na	20.05	±	31.41	0.2551	±	0.3998
* Mg	27.33	±	9.561	0.3479	±	0.1217
Al	143.1	±	17.73	1.821	±	0.2257
Si	797.1	±	74.47	10.15	±	0.9479
P	1.667	±	0.2509	0.0212	±	0.0032
S	0.6328	±	0.1379	0.0081	±	0.0018
Cl	0.3537	±	0.1119	0.0045	±	0.0014
K	47.89	±	2.606	0.6095	±	0.0332
Ca	88.07	±	4.691	1.121	±	0.0597
Ti	5.310	±	0.2768	0.0676	±	0.0035
V	0.1503	±	0.0328	0.0019	±	0.0004
Cr	0.6226	±	0.0565	0.0079	±	0.0007
Mn	1.125	±	0.0633	0.0143	±	0.0008
Fe	51.74	±	2.594	0.6586	±	0.0330
* Co	0.0000	±	0.0249	0.0000	±	0.0003
Ni	0.2418	±	0.0181	0.0031	±	0.0002
Cu	0.5277	±	0.0452	0.0067	±	0.0006
Zn	0.4012	±	0.0362	0.0051	±	0.0005
* Ga	0.0226	±	0.0079	0.0003	±	0.0001
* Ge	0.0000	±	0.0079	0.0000	±	0.0001
* As	0.0328	±	0.0113	0.0004	±	0.0001
* Se	0.0079	±	0.0056	0.0001	±	0.0001
Br	0.0441	±	0.0056	0.0006	±	0.0001
Rb	0.2384	±	0.0147	0.0030	±	0.0002
Sr	0.5254	±	0.0282	0.0067	±	0.0004
Y	0.0452	±	0.0090	0.0006	±	0.0001
Zr	0.2791	±	0.0181	0.0036	±	0.0002
* Mo	0.0000	±	0.0158	0.0000	±	0.0002
* Pd	0.0203	±	0.0362	0.0003	±	0.0005
* Ag	0.0000	±	0.0373	0.0000	±	0.0005
* Cd	0.0000	±	0.0362	0.0000	±	0.0005
* In	0.0000	±	0.0407	0.0000	±	0.0005
Sn	0.1729	±	0.0520	0.0022	±	0.0007
* Sb	0.0000	±	0.0531	0.0000	±	0.0007
Ba	2.164	±	0.1752	0.0275	±	0.0022
* La	0.0000	±	0.1480	0.0000	±	0.0019
* Hf	0.0000	±	0.0305	0.0000	±	0.0004
Hg	0.0475	±	0.0147	0.0006	±	0.0002
Pb	0.1469	±	0.0181	0.0019	±	0.0002

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1842
Client ID: PS-OD-PM10-062512-03
Filter ID: P0458992
Sample Date: 6/25/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	3,157.	±	10.			
XRF						
* Na	5.867	±	5.782	0.1858	±	0.1832
Mg	10.08	±	2.390	0.3192	±	0.0757
Al	58.53	±	5.147	1.854	±	0.1631
Si	404.3	±	28.65	12.81	±	0.9083
P	0.6724	±	0.0927	0.0213	±	0.0029
* S	0.1559	±	0.0565	0.0049	±	0.0018
* Cl	0.1435	±	0.0633	0.0045	±	0.0020
K	24.80	±	1.300	0.7857	±	0.0412
Ca	44.96	±	2.323	1.424	±	0.0737
Ti	2.963	±	0.1559	0.0939	±	0.0049
V	0.0994	±	0.0203	0.0031	±	0.0006
Cr	0.2011	±	0.0170	0.0064	±	0.0005
Mn	0.6204	±	0.0373	0.0197	±	0.0012
Fe	27.74	±	1.394	0.8787	±	0.0443
* Co	0.0000	±	0.0181	0.0000	±	0.0006
* Ni	0.0249	±	0.0090	0.0008	±	0.0003
Cu	0.1412	±	0.0192	0.0045	±	0.0006
Zn	0.1684	±	0.0203	0.0053	±	0.0006
* Ga	0.0170	±	0.0068	0.0005	±	0.0002
* Ge	0.0045	±	0.0068	0.0001	±	0.0002
* As	0.0045	±	0.0090	0.0001	±	0.0003
* Se	0.0056	±	0.0056	0.0002	±	0.0002
* Br	0.0147	±	0.0056	0.0005	±	0.0002
Rb	0.1254	±	0.0090	0.0040	±	0.0003
Sr	0.2746	±	0.0158	0.0087	±	0.0005
* Y	0.0113	±	0.0090	0.0004	±	0.0003
Zr	0.1435	±	0.0136	0.0045	±	0.0004
* Mo	0.0124	±	0.0147	0.0004	±	0.0005
* Pd	0.0000	±	0.0328	0.0000	±	0.0010
* Ag	0.0000	±	0.0328	0.0000	±	0.0010
* Cd	0.0000	±	0.0328	0.0000	±	0.0010
* In	0.0000	±	0.0362	0.0000	±	0.0011
* Sn	0.0000	±	0.0452	0.0000	±	0.0014
* Sb	0.0000	±	0.0497	0.0000	±	0.0016
Ba	0.5119	±	0.1051	0.0162	±	0.0033
* La	0.0000	±	0.0893	0.0000	±	0.0028
* Hf	0.0000	±	0.0271	0.0000	±	0.0009
* Hg	0.0000	±	0.0147	0.0000	±	0.0005
Pb	0.0588	±	0.0147	0.0019	±	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1843
Client ID: PS-OD-PM2.5-062612-01
Filter ID: P0458993
Sample Date: 6/26/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,949.	±	10.			
XRF						
* Na	3.501	±	2.511	0.1796	±	0.1288
Mg	4.793	±	0.9650	0.2459	±	0.0495
Al	30.51	±	2.396	1.565	±	0.1232
Si	180.6	±	11.63	9.265	±	0.5985
P	0.1898	±	0.0429	0.0097	±	0.0022
S	0.2023	±	0.0339	0.0104	±	0.0017
* Cl	0.1074	±	0.0475	0.0055	±	0.0024
K	12.49	±	0.6486	0.6407	±	0.0334
Ca	19.80	±	1.014	1.016	±	0.0523
Ti	1.434	±	0.0825	0.0736	±	0.0042
* V	0.0418	±	0.0158	0.0021	±	0.0008
Cr	0.6091	±	0.0339	0.0313	±	0.0017
Mn	0.3480	±	0.0249	0.0179	±	0.0013
Fe	17.13	±	0.8633	0.8790	±	0.0445
* Co	0.0000	±	0.0147	0.0000	±	0.0008
Ni	0.2158	±	0.0158	0.0111	±	0.0008
Cu	0.4091	±	0.0362	0.0210	±	0.0019
Zn	0.2904	±	0.0192	0.0149	±	0.0010
* Ga	0.0034	±	0.0068	0.0002	±	0.0003
* Ge	0.0079	±	0.0056	0.0004	±	0.0003
* As	0.0034	±	0.0102	0.0002	±	0.0005
* Se	0.0011	±	0.0056	0.0001	±	0.0003
Br	0.0271	±	0.0056	0.0014	±	0.0003
Rb	0.0644	±	0.0068	0.0033	±	0.0003
Sr	0.1141	±	0.0090	0.0059	±	0.0005
* Y	0.0158	±	0.0079	0.0008	±	0.0004
Zr	0.0780	±	0.0113	0.0040	±	0.0006
* Mo	0.0079	±	0.0147	0.0004	±	0.0008
* Pd	0.0000	±	0.0294	0.0000	±	0.0015
* Ag	0.0000	±	0.0294	0.0000	±	0.0015
* Cd	0.0000	±	0.0305	0.0000	±	0.0016
* In	0.0079	±	0.0350	0.0004	±	0.0018
* Sn	0.0000	±	0.0452	0.0000	±	0.0023
* Sb	0.0000	±	0.0463	0.0000	±	0.0024
Ba	0.6283	±	0.0644	0.0322	±	0.0033
* La	0.0000	±	0.0599	0.0000	±	0.0031
* Hf	0.0000	±	0.0271	0.0000	±	0.0014
* Hg	0.0000	±	0.0147	0.0000	±	0.0008
Pb	0.1040	±	0.0158	0.0053	±	0.0008

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1844
Client ID: BS-OD-PM2.5-062812
Filter ID: P0458994
Sample Date: 6/28/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,402.	±	10.			
XRF						
* Na	2.848	±	1.668	0.2031	±	0.1190
Mg	5.006	±	0.7288	0.3571	±	0.0520
Al	24.65	±	1.837	1.758	±	0.1317
Si	76.18	±	4.703	5.434	±	0.3377
P	0.1672	±	0.0350	0.0119	±	0.0025
S	0.5356	±	0.0407	0.0382	±	0.0029
Cl	0.1785	±	0.0486	0.0127	±	0.0035
K	10.21	±	0.5277	0.7284	±	0.0380
Ca	9.537	±	0.4904	0.6803	±	0.0353
Ti	1.389	±	0.0814	0.0991	±	0.0058
* V	0.0294	±	0.0170	0.0021	±	0.0012
* Cr	0.0158	±	0.0102	0.0011	±	0.0007
Mn	0.3198	±	0.0226	0.0228	±	0.0016
Fe	13.93	±	0.7040	0.9938	±	0.0507
* Co	0.0000	±	0.0136	0.0000	±	0.0010
* Ni	0.0056	±	0.0068	0.0004	±	0.0005
Cu	0.0429	±	0.0079	0.0031	±	0.0006
Zn	0.0531	±	0.0090	0.0038	±	0.0006
* Ga	0.0113	±	0.0079	0.0008	±	0.0006
* Ge	0.0147	±	0.0068	0.0010	±	0.0005
* As	0.0000	±	0.0102	0.0000	±	0.0007
* Se	0.0124	±	0.0056	0.0009	±	0.0004
Br	0.0226	±	0.0056	0.0016	±	0.0004
Rb	0.0610	±	0.0079	0.0044	±	0.0006
Sr	0.0994	±	0.0090	0.0071	±	0.0006
* Y	0.0034	±	0.0090	0.0002	±	0.0006
Zr	0.0644	±	0.0124	0.0046	±	0.0009
* Mo	0.0136	±	0.0170	0.0010	±	0.0012
* Pd	0.0000	±	0.0316	0.0000	±	0.0023
* Ag	0.0000	±	0.0328	0.0000	±	0.0023
* Cd	0.0000	±	0.0316	0.0000	±	0.0023
* In	0.0000	±	0.0362	0.0000	±	0.0026
* Sn	0.0000	±	0.0441	0.0000	±	0.0031
* Sb	0.0045	±	0.0497	0.0003	±	0.0035
Ba	0.5074	±	0.0610	0.0362	±	0.0044
* La	0.1243	±	0.0475	0.0089	±	0.0034
* Hf	0.0181	±	0.0294	0.0013	±	0.0021
* Hg	0.0000	±	0.0158	0.0000	±	0.0011
* Pb	0.0339	±	0.0158	0.0024	±	0.0011

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1847
Client ID: PS-OD-PM10-062612-01
Filter ID: P0458997
Sample Date: 6/26/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,838.	±	10.			
XRF						
* Na	0.6961	±	4.871	0.0245	±	0.1716
Mg	6.295	±	1.783	0.2218	±	0.0628
Al	45.21	±	3.836	1.593	±	0.1353
Si	272.3	±	18.64	9.596	±	0.6578
P	0.4441	±	0.0701	0.0156	±	0.0025
S	0.4204	±	0.0531	0.0148	±	0.0019
Cl	0.1842	±	0.0599	0.0065	±	0.0021
K	17.37	±	0.9063	0.6120	±	0.0320
Ca	26.58	±	1.370	0.9365	±	0.0484
Ti	2.116	±	0.1153	0.0746	±	0.0041
V	0.0780	±	0.0192	0.0027	±	0.0007
Cr	0.8306	±	0.0452	0.0293	±	0.0016
Mn	0.5175	±	0.0328	0.0182	±	0.0012
Fe	23.83	±	1.199	0.8397	±	0.0423
* Co	0.0000	±	0.0170	0.0000	±	0.0006
Ni	0.3175	±	0.0215	0.0112	±	0.0008
Cu	0.5932	±	0.0599	0.0209	±	0.0021
Zn	0.4328	±	0.0384	0.0152	±	0.0014
* Ga	0.0226	±	0.0079	0.0008	±	0.0003
* Ge	0.0158	±	0.0068	0.0006	±	0.0002
* As	0.0113	±	0.0113	0.0004	±	0.0004
* Se	0.0056	±	0.0056	0.0002	±	0.0002
Br	0.0305	±	0.0056	0.0011	±	0.0002
Rb	0.0938	±	0.0079	0.0033	±	0.0003
Sr	0.1955	±	0.0136	0.0069	±	0.0005
* Y	0.0136	±	0.0090	0.0005	±	0.0003
Zr	0.1062	±	0.0136	0.0037	±	0.0005
* Mo	0.0000	±	0.0170	0.0000	±	0.0006
* Pd	0.0000	±	0.0339	0.0000	±	0.0012
* Ag	0.0000	±	0.0339	0.0000	±	0.0012
* Cd	0.0000	±	0.0328	0.0000	±	0.0012
* In	0.0000	±	0.0373	0.0000	±	0.0013
Sn	0.1559	±	0.0486	0.0055	±	0.0017
* Sb	0.0000	±	0.0497	0.0000	±	0.0018
Ba	0.4644	±	0.0825	0.0164	±	0.0029
* La	0.0000	±	0.0757	0.0000	±	0.0027
* Hf	0.0000	±	0.0305	0.0000	±	0.0011
* Hg	0.0000	±	0.0170	0.0000	±	0.0006
Pb	0.1288	±	0.0181	0.0045	±	0.0006

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1850
Client ID: PS-OD-PM2.5-062712-01
Filter ID: P0459000
Sample Date: 6/27/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,873.	±	10.			
XRF						
* Na	0.5322	±	1.758	0.0284	±	0.0939
Mg	2.763	±	0.5932	0.1475	±	0.0317
Al	17.68	±	1.388	0.9442	±	0.0743
Si	103.6	±	6.561	5.534	±	0.3515
* P	0.0927	±	0.0339	0.0049	±	0.0018
S	0.0972	±	0.0249	0.0052	±	0.0013
* Cl	0.0463	±	0.0407	0.0025	±	0.0022
K	6.770	±	0.3548	0.3614	±	0.0190
Ca	11.15	±	0.5729	0.5953	±	0.0308
Ti	0.8012	±	0.0531	0.0428	±	0.0028
* V	0.0181	±	0.0136	0.0010	±	0.0007
Cr	0.3390	±	0.0203	0.0181	±	0.0011
Mn	0.2170	±	0.0192	0.0116	±	0.0010
Fe	10.08	±	0.5119	0.5384	±	0.0275
* Co	0.0000	±	0.0113	0.0000	±	0.0006
Ni	0.1220	±	0.0113	0.0065	±	0.0006
Cu	0.2158	±	0.0147	0.0115	±	0.0008
Zn	0.1842	±	0.0215	0.0098	±	0.0011
* Ga	0.0045	±	0.0068	0.0002	±	0.0004
* Ge	0.0113	±	0.0056	0.0006	±	0.0003
* As	0.0000	±	0.0090	0.0000	±	0.0005
* Se	0.0056	±	0.0056	0.0003	±	0.0003
Br	0.0282	±	0.0045	0.0015	±	0.0002
Rb	0.0282	±	0.0056	0.0015	±	0.0003
Sr	0.0757	±	0.0079	0.0040	±	0.0004
* Y	0.0215	±	0.0079	0.0011	±	0.0004
* Zr	0.0294	±	0.0102	0.0016	±	0.0005
* Mo	0.0090	±	0.0147	0.0005	±	0.0008
* Pd	0.0000	±	0.0294	0.0000	±	0.0016
* Ag	0.0000	±	0.0294	0.0000	±	0.0016
* Cd	0.0000	±	0.0294	0.0000	±	0.0016
* In	0.0000	±	0.0328	0.0000	±	0.0017
* Sn	0.0000	±	0.0418	0.0000	±	0.0022
* Sb	0.0000	±	0.0441	0.0000	±	0.0024
Ba	0.3232	±	0.0486	0.0173	±	0.0026
* La	0.0000	±	0.0373	0.0000	±	0.0020
* Hf	0.0034	±	0.0249	0.0002	±	0.0013
* Hg	0.0000	±	0.0136	0.0000	±	0.0007
Pb	0.0644	±	0.0147	0.0034	±	0.0008

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1851
Client ID: PS-OD-PM10-062712-01
Filter ID: P0459651
Sample Date: 6/27/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,169.	±	10.			
XRF						
* Na	0.1107	±	1.620	0.0095	±	0.1386
Mg	2.352	±	0.5571	0.2012	±	0.0477
Al	16.96	±	1.268	1.451	±	0.1092
Si	105.0	±	6.404	8.985	±	0.5532
* P	0.0000	±	0.0328	0.0000	±	0.0028
* S	0.0282	±	0.0260	0.0024	±	0.0022
* Cl	0.0870	±	0.0452	0.0074	±	0.0039
K	6.735	±	0.3526	0.5761	±	0.0306
Ca	10.82	±	0.5548	0.9256	±	0.0481
Ti	0.7854	±	0.0441	0.0672	±	0.0038
* V	0.0102	±	0.0102	0.0009	±	0.0009
Cr	0.1966	±	0.0147	0.0168	±	0.0013
Mn	0.1864	±	0.0170	0.0159	±	0.0015
Fe	8.376	±	0.4260	0.7165	±	0.0370
* Co	0.0000	±	0.0113	0.0000	±	0.0010
Ni	0.0565	±	0.0090	0.0048	±	0.0008
Cu	0.1458	±	0.0203	0.0125	±	0.0017
Zn	0.1469	±	0.0203	0.0126	±	0.0017
* Ga	0.0000	±	0.0079	0.0000	±	0.0007
* Ge	0.0000	±	0.0068	0.0000	±	0.0006
As	0.0282	±	0.0068	0.0024	±	0.0006
* Se	0.0000	±	0.0056	0.0000	±	0.0005
Br	0.0181	±	0.0056	0.0015	±	0.0005
Rb	0.0294	±	0.0068	0.0025	±	0.0006
Sr	0.0565	±	0.0079	0.0048	±	0.0007
Y	0.0339	±	0.0102	0.0029	±	0.0009
* Zr	0.0249	±	0.0124	0.0021	±	0.0011
* Mo	0.0034	±	0.0170	0.0003	±	0.0014
* Pd	0.0000	±	0.0316	0.0000	±	0.0027
* Ag	0.0000	±	0.0316	0.0000	±	0.0027
* Cd	0.0000	±	0.0328	0.0000	±	0.0028
* In	0.0000	±	0.0362	0.0000	±	0.0031
* Sn	0.0000	±	0.0452	0.0000	±	0.0039
* Sb	0.0000	±	0.0508	0.0000	±	0.0043
* Ba	0.0000	±	0.0486	0.0000	±	0.0042
* La	0.0113	±	0.0407	0.0010	±	0.0035
* Hf	0.0000	±	0.0294	0.0000	±	0.0025
* Hg	0.0000	±	0.0136	0.0000	±	0.0012
* Pb	0.0170	±	0.0158	0.0014	±	0.0014

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-T1853
Client ID: BS-OD-PM10-062812
Filter ID: P0460353
Sample Date: 6/28/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: loose PM in slide was not weighed

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,061.	±	10.			
XRF						
* Na	0.1040	±	1.474	0.0098	±	0.1389
Mg	4.350	±	0.6588	0.4100	±	0.0622
Al	25.62	±	1.861	2.414	±	0.1769
Si	79.21	±	4.802	7.466	±	0.4581
P	0.1390	±	0.0350	0.0131	±	0.0033
S	0.4961	±	0.0802	0.0468	±	0.0076
Cl	0.5763	±	0.0622	0.0543	±	0.0059
K	10.36	±	0.5345	0.9766	±	0.0512
Ca	9.754	±	0.5006	0.9193	±	0.0480
Ti	1.477	±	0.0859	0.1392	±	0.0082
V	0.0542	±	0.0170	0.0051	±	0.0016
* Cr	0.0124	±	0.0102	0.0012	±	0.0010
Mn	0.3322	±	0.0237	0.0313	±	0.0023
Fe	14.02	±	0.7085	1.322	±	0.0679
* Co	0.0000	±	0.0136	0.0000	±	0.0013
* Ni	0.0000	±	0.0068	0.0000	±	0.0006
Cu	0.0294	±	0.0079	0.0028	±	0.0007
Zn	0.0508	±	0.0090	0.0048	±	0.0009
* Ga	0.0181	±	0.0079	0.0017	±	0.0007
Ge	0.0215	±	0.0068	0.0020	±	0.0006
* As	0.0011	±	0.0102	0.0001	±	0.0010
* Se	0.0102	±	0.0068	0.0010	±	0.0006
Br	0.0181	±	0.0056	0.0017	±	0.0005
Rb	0.0508	±	0.0079	0.0048	±	0.0007
Sr	0.0881	±	0.0090	0.0083	±	0.0009
* Y	0.0203	±	0.0102	0.0019	±	0.0010
Zr	0.0655	±	0.0124	0.0062	±	0.0012
* Mo	0.0384	±	0.0181	0.0036	±	0.0017
* Pd	0.0000	±	0.0328	0.0000	±	0.0031
* Ag	0.0000	±	0.0328	0.0000	±	0.0031
* Cd	0.0000	±	0.0328	0.0000	±	0.0031
* In	0.0000	±	0.0373	0.0000	±	0.0035
* Sn	0.0000	±	0.0441	0.0000	±	0.0042
* Sb	0.0000	±	0.0508	0.0000	±	0.0048
Ba	0.5627	±	0.0655	0.0530	±	0.0062
* La	0.0000	±	0.0622	0.0000	±	0.0059
* Hf	0.0407	±	0.0294	0.0038	±	0.0028
* Hg	0.0000	±	0.0170	0.0000	±	0.0016
* Pb	0.0373	±	0.0158	0.0035	±	0.0015

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1607
Client ID: PS-OD-PM10 Imp-061612-01
Sample Date: 6/16/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	39.7	0.600
Ca	126.	0.200
Fe	43.7	0.080
Hf	< MDL	0.080
K	11.2	0.200
Mg	11.6	0.080
Mn	0.865	0.008
Na	6.20	0.480
Pb	0.460	0.200
Zr	0.099	0.040

Lab ID: 12-X1608
Client ID: PS-OD-PM10 Imp-061612-02
Sample Date: 6/16/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	49.5	0.600
Ca	168.	0.200
Fe	51.7	0.080
Hf	< MDL	0.080
K	14.7	0.200
Mg	15.4	0.080
Mn	1.05	0.008
Na	5.60	0.480
Pb	0.519	0.200
Zr	0.107	0.040

Lab ID: 12-X1609
Client ID: PS-OD-PM10 Imp-061612-03
Sample Date: 6/16/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	52.5	0.600
Ca	170.	0.200
Fe	56.8	0.080
Hf	< MDL	0.080
K	14.9	0.200
Mg	17.4	0.080
Mn	0.980	0.008
Na	7.02	0.480
Pb	0.430	0.200
Zr	0.117	0.040

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1610
Client ID: PS-OD-PM10 Imp-061812-01
Sample Date: 6/18/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	6.51	0.600
Ca	33.5	0.200
Fe	4.95	0.080
Hf	< MDL	0.080
K	2.22	0.200
Mg	1.54	0.080
Mn	0.127	0.008
Na	4.07	0.480
Pb	0.248	0.200
Zr	0.064	0.040

Lab ID: 12-X1611
Client ID: PS-OD-PM10 Imp-061912-01
Sample Date: 6/19/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	53.0	0.600
Ca	140.	0.200
Fe	54.4	0.080
Hf	< MDL	0.080
K	15.3	0.200
Mg	14.1	0.080
Mn	0.995	0.008
Na	6.13	0.480
Pb	0.281	0.200
Zr	0.190	0.040

Lab ID: 12-X1612
Client ID: BS-OD-PM10 Imp-062012-01
Sample Date: 6/20/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	1.67	0.600
Ca	106.	0.200
Fe	1.50	0.080
Hf	< MDL	0.080
K	1.09	0.200
Mg	0.625	0.080
Mn	0.071	0.008
Na	3.53	0.480
Pb	0.264	0.200
Zr	0.043	0.040

Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1613
Client ID: PS-OD-PM10 Imp-062112-02-OR
Sample Date: 6/21/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	45.8	0.600
Ca	204.	0.200
Fe	42.9	0.080
Hf	< MDL	0.080
K	13.3	0.200
Mg	11.5	0.080
Mn	0.918	0.008
Na	5.96	0.480
Pb	0.466	0.200
Zr	0.191	0.040

Lab ID: 12-X1614
Client ID: PS-OD-PM10 Imp-062112-03
Sample Date: 6/21/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	34.6	0.600
Ca	123.	0.200
Fe	32.6	0.080
Hf	< MDL	0.080
K	9.94	0.200
Mg	8.08	0.080
Mn	0.626	0.008
Na	5.85	0.480
Pb	0.391	0.200
Zr	0.162	0.040

Lab ID: 12-X1615
Client ID: PS-OD-PM10 Imp-062112-04-OR
Sample Date: 6/21/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	45.2	0.600
Ca	197.	0.200
Fe	40.8	0.080
Hf	< MDL	0.080
K	13.0	0.200
Mg	11.5	0.080
Mn	0.830	0.008
Na	5.65	0.480
Pb	0.480	0.200
Zr	0.201	0.040

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1616
Client ID: PS-OD-PM10 Imp-062212-01-W1
Sample Date: 6/22/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	49.4	0.600
Ca	84.6	0.200
Fe	48.4	0.080
Hf	< MDL	0.080
K	13.3	0.200
Mg	13.6	0.080
Mn	0.894	0.008
Na	5.85	0.480
Pb	0.457	0.200
Zr	0.099	0.040

Lab ID: 12-X1617
Client ID: PS-OD-PM10 Imp-062312-01
Sample Date: 6/23/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	580.	0.600
Ca	940.	0.200
Fe	619.	0.080
Hf	< MDL	0.080
K	163.	0.200
Mg	196.	0.080
Mn	13.2	0.008
Na	23.1	0.480
Pb	0.816	0.200
Zr	0.572	0.040

Lab ID: 12-X1618
Client ID: PS-OD-PM10 Imp-062312-02-OR
Sample Date: 6/23/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	1,630	0.600
Ca	2,240	0.200
Fe	1,820	0.080
Hf	< MDL	0.080
K	420.	0.200
Mg	532.	0.080
Mn	35.1	0.008
Na	60.2	0.480
Pb	1.32	0.200
Zr	1.22	0.040

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1619
Client ID: PS-OD-PM10 Imp-062512-01
Sample Date: 6/25/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	244.	0.600
Ca	323.	0.200
Fe	265.	0.080
Hf	< MDL	0.080
K	65.6	0.200
Mg	73.0	0.080
Mn	5.52	0.008
Na	10.3	0.480
Pb	0.548	0.200
Zr	0.306	0.040

Lab ID: 12-X1620
Client ID: PS-OD-PM10 Imp-062512-02-OR
Sample Date: 6/25/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	453.	0.600
Ca	537.	0.200
Fe	477.	0.080
Hf	< MDL	0.080
K	133.	0.200
Mg	148.	0.080
Mn	10.1	0.008
Na	18.8	0.480
Pb	0.627	0.200
Zr	0.526	0.040

Lab ID: 12-X1621
Client ID: PS-OD-PM10 Imp-062512-03
Sample Date: 6/25/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	28.0	0.600
Ca	142.	0.200
Fe	24.7	0.080
Hf	< MDL	0.080
K	8.78	0.200
Mg	8.25	0.080
Mn	0.616	0.008
Na	4.38	0.480
Pb	0.394	0.200
Zr	0.049	0.040

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-568

Lab ID: 12-X1622
Client ID: PS-OD-PM10 Imp-062512-04-OR
Sample Date: 6/25/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	10.0	0.600
Ca	55.4	0.200
Fe	9.27	0.080
Hf	< MDL	0.080
K	3.41	0.200
Mg	2.98	0.080
Mn	0.230	0.008
Na	3.49	0.480
Pb	0.273	0.200
Zr	< MDL	0.040

Lab ID: 12-X1623
Client ID: PS-OD-PM10 Imp-062612-01
Sample Date: 6/26/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	120.	0.600
Ca	221.	0.200
Fe	117.	0.080
Hf	< MDL	0.080
K	32.6	0.200
Mg	34.4	0.080
Mn	2.45	0.008
Na	8.69	0.480
Pb	0.498	0.200
Zr	0.163	0.040

Lab ID: 12-X1624
Client ID: PS-OD-PM10 Imp-062712-01
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: >PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	42.5	0.600
Ca	184.	0.200
Fe	42.8	0.080
Hf	< MDL	0.080
K	12.4	0.200
Mg	11.8	0.080
Mn	0.903	0.008
Na	5.44	0.480
Pb	0.494	0.200
Zr	0.060	0.040

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

QA/QC

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

Filbert Log File

Filter	Mass	Units	Balance	Temp.	Hum.	Initials	Date	Time	Net	Procedure
Cal Check	199.999	mg	ME5	21.5	32	JMS	12/22/12	21:36		
Cal Check	100.003	mg	ME5	21.5	32	JMS	12/22/12	21:39		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	21:40		
12-T1302	155.763	mg	ME5	21.5	32	JMS	12/22/12	21:41	10.612	Gross
12-T1803	149.989	mg	ME5	21.5	32	JMS	12/22/12	21:42	7.260	Gross
12-T1804	148.743	mg	ME5	21.5	32	JMS	12/22/12	21:43	4.435	Gross
12-T1806	151.332	mg	ME5	21.5	32	JMS	12/22/12	21:45	8.739	Gross
12-T1809	148.888	mg	ME5	21.5	32	JMS	12/22/12	21:47	5.864	Gross
12-T1810	153.433	mg	ME5	21.5	32	JMS	12/22/12	21:49	10.511	Gross
12-T1811	144.753	mg	ME5	21.5	32	JMS	12/22/12	21:51	2.518	Gross
12-T1812	145.905	mg	ME5	21.5	32	JMS	12/22/12	21:54	3.198	Gross
12-T1814	146.163	mg	ME5	21.5	32	JMS	12/22/12	21:56	2.741	Gross
12-T1816	145.566	mg	ME5	21.5	32	JMS	12/22/12	21:59	3.443	Gross
Cal Check	199.998	mg	ME5	21.5	32	JMS	12/22/12	22:03		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	22:04		
12-T1817	147.256	mg	ME5	21.5	32	JMS	12/22/12	22:06	2.332	Gross
12-T1819	153.669	mg	ME5	21.5	32	JMS	12/22/12	22:10	7.267	Gross
12-T1820	151.917	mg	ME5	21.5	32	JMS	12/22/12	22:13	4.499	Gross
12-T1821	145.260	mg	ME5	21.5	32	JMS	12/22/12	22:14	0.266	Gross
12-T1822	151.119	mg	ME5	21.5	32	JMS	12/22/12	22:17	4.144	Gross
12-T1823	144.959	mg	ME5	21.5	32	JMS	12/22/12	22:20	0.197	Gross
12-T1824	162.009	mg	ME5	21.5	32	JMS	12/22/12	22:24	16.310	Gross
12-T1825	148.968	mg	ME5	21.5	32	JMS	12/22/12	22:29	2.490	Gross
12-T1827	145.086	mg	ME5	21.5	32	JMS	12/22/12	22:31	1.961	Gross
12-T1828	146.181	mg	ME5	21.5	32	JMS	12/22/12	22:32	0.982	Gross
Cal Check	100.003	mg	ME5	21.5	32	JMS	12/22/12	22:37		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	22:38		
12-T1829	148.221	mg	ME5	21.5	32	JMS	12/22/12	22:38	4.023	Gross
12-T1830	157.844	mg	ME5	21.5	32	JMS	12/22/12	22:39	10.485	Gross
12-T1831	154.152	mg	ME5	21.5	32	JMS	12/22/12	22:41	9.146	Gross
12-T1832	144.461	mg	ME5	21.5	32	JMS	12/22/12	22:42	2.520	Gross
12-T1833	149.034	mg	ME5	21.5	32	JMS	12/22/12	22:43	4.589	Gross
12-T1834	145.130	mg	ME5	21.5	32	JMS	12/22/12	22:45	1.735	Gross
12-T1835	152.712	mg	ME5	21.5	32	JMS	12/22/12	22:47	9.505	Gross
12-T1836	149.176	mg	ME5	21.5	32	JMS	12/22/12	22:49	5.683	Gross
12-T1837	153.141	mg	ME5	21.5	32	JMS	12/22/12	22:51	9.544	Gross
12-T1840	142.957	mg	ME5	21.5	32	JMS	12/22/12	22:52	1.602	Gross
Cal Check	199.999	mg	ME5	21.5	32	JMS	12/22/12	22:54		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	22:54		
12-T1841	150.902	mg	ME5	21.5	32	JMS	12/22/12	22:55	7.857	Gross
12-T1842	147.071	mg	ME5	21.5	32	JMS	12/22/12	22:57	3.157	Gross
12-T1843	142.963	mg	ME5	21.5	32	JMS	12/22/12	22:58	1.949	Gross
12-T1844	147.678	mg	ME5	21.5	32	JMS	12/22/12	23:00	1.402	Gross
12-T1847	149.468	mg	ME5	21.5	32	JMS	12/22/12	23:01	2.838	Gross
12-T1850	145.500	mg	ME5	21.5	32	JMS	12/22/12	23:03	1.873	Gross
12-T1851	144.589	mg	ME5	21.5	32	JMS	12/22/12	23:05	1.169	Gross
12-T1853	148.315	mg	ME5	21.5	32	JMS	12/22/12	23:08	1.061	Gross
~~12-T3056~~	~~0.000~~	~~mg~~	~~ME5~~	~~21.5~~	~~32~~	~~JMS~~	~~12/22/12~~	~~23:10~~	~~-141.364~~	~~Gross~~
~~12-T3056~~	~~0.000~~	~~mg~~	~~ME5~~	~~21.5~~	~~32~~	~~JMS~~	~~12/22/12~~	~~23:11~~	~~-141.364~~	~~Gross~~
Cal Check	100.003	mg	ME5	21.5	32	JMS	12/22/12	23:13		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	23:14		
12-T3056	141.678	mg	ME5	21.5	32	JMS	12/22/12	23:15	0.314	Gross
12-T3057	142.319	mg	ME5	21.5	32	JMS	12/22/12	23:17	0.314	Gross

200 mg: 199.999 ± 3 µg
100 mg: 100.003 ± 3 µg

Printed 1/17/13 at 20:01
Filename: 121222MG.xls

Filbert Log File

Filter	Mass	Units	Balance	Temp.	Hum.	Initials	Date	Time	Net	Procedure
12-T3058	141.944	mg	ME5	21.5	32	JMS	12/22/12	23:18	0.382	Gross
12-T3059	141.765	mg	ME5	21.5	32	JMS	12/22/12	23:20	0.125	Gross
12-T3182	142.345	mg	ME5	21.5	32	JMS	12/22/12	23:24	0.096	Gross
12-T3183	140.817	mg	ME5	21.5	32	JMS	12/22/12	23:25	0.106	Gross
12-T3184	142.003	mg	ME5	21.5	32	JMS	12/22/12	23:25	0.073	Gross
12-T3185	140.585	mg	ME5	21.5	32	JMS	12/22/12	23:26	0.113	Gross
Cal Check	199.998	mg	ME5	21.5	32	JMS	12/22/12	23:29		
Cal Check	100.003	mg	ME5	21.5	32	JMS	12/22/12	23:30		
Cal Check	0.000	mg	ME5	21.5	32	JMS	12/22/12	23:32		
Cal Check	200.000	mg	ME5	21.2	32	JMS	12/27/12	19:17		
Cal Check	100.004	mg	ME5	21.2	32	JMS	12/27/12	19:19		
Cal Check	0.000	mg	ME5	21.2	32	JMS	12/27/12	19:19		
12-T1812	145.512	mg	ME5	21.2	32	JMS	12/27/12	19:20	-0.393	QA Gross
12-T1812	145.683	mg	ME5	21.2	32	JMS	12/27/12	19:22	-0.222	QA Gross
12-T1820	151.795	mg	ME5	21.2	32	JMS	12/27/12	19:23	-0.122	QA Gross
12-T1834	145.131	mg	ME5	21.2	32	JMS	12/27/12	19:24	0.001	QA Gross
12-T1844	147.734	mg	ME5	21.2	32	JMS	12/27/12	19:24	0.056	QA Gross
12-T3057	142.318	mg	ME5	21.2	32	JMS	12/27/12	19:26	-0.001	QA Gross
12-T3184	142.001	mg	ME5	21.2	32	JMS	12/27/12	19:28	-0.002	QA Gross
12-T4178	141.356	mg	ME5	21.2	32	JMS	12/27/12	19:28	-0.018	QA Gross
12-T4178	141.378	mg	ME5	21.2	32	JMS	12/27/12	19:33	0.004	QA Gross
Cal Check	199.996	mg	ME5	21.2	32	JMS	12/27/12	19:35		
Cal Check	0.000	mg	ME5	21.2	32	JMS	12/27/12	19:38		
Cal Check	100.005	mg	ME5	21.2	32	JMS	12/27/12	19:40		
Cal Check	199.998	mg	ME5	21.2	32	JMS	12/27/12	19:41		
Cal Check	0.000	mg	ME5	21.2	32	JMS	12/27/12	19:41		
Cal Check	199.998	mg	ME5	20.9	35	JMS	01/17/13	18:38		Post XRF Reweights
Cal Check	100.004	mg	ME5	20.9	35	JMS	01/17/13	18:39		
Cal Check	0.000	mg	ME5	20.9	35	JMS	01/17/13	18:39		
12-T1302	151.295	mg	ME5	20.9	35	JMS	01/17/13	18:40	-4.468	QA Gross
12-T1803	147.997	mg	ME5	20.9	35	JMS	01/17/13	18:41	-1.992	QA Gross
12-T1804	146.560	mg	ME5	20.9	35	JMS	01/17/13	18:41	-2.183	QA Gross
12-T1806	149.109	mg	ME5	20.9	35	JMS	01/17/13	18:43	-2.223	QA Gross
12-T1809	144.797	mg	ME5	20.9	35	JMS	01/17/13	18:45	-4.091	QA Gross
12-T1810	150.953	mg	ME5	20.9	35	JMS	01/17/13	18:46	-2.480	QA Gross
12-T1811	143.551	mg	ME5	20.9	35	JMS	01/17/13	18:48	-1.202	QA Gross
12-T1812	143.778	mg	ME5	20.9	35	JMS	01/17/13	18:49	-2.127	QA Gross
12-T1814	144.713	mg	ME5	20.9	35	JMS	01/17/13	18:51	-1.450	QA Gross
12-T1816	143.536	mg	ME5	20.9	35	JMS	01/17/13	18:52	-2.030	QA Gross
Cal Check	199.998	mg	ME5	20.9	35	JMS	01/17/13	18:53		
Cal Check	0.000	mg	ME5	20.9	35	JMS	01/17/13	18:53		
12-T1817	146.194	mg	ME5	20.9	35	JMS	01/17/13	18:57	-1.062	QA Gross
12-T1819	148.839	mg	ME5	20.9	35	JMS	01/17/13	18:59	-4.830	QA Gross
12-T1820	149.622	mg	ME5	20.9	35	JMS	01/17/13	19:00	-2.295	QA Gross
12-T1821	145.184	mg	ME5	20.9	35	JMS	01/17/13	19:02	-0.076	QA Gross
12-T1822	149.285	mg	ME5	20.9	35	JMS	01/17/13	19:03	-1.834	QA Gross
12-T1823	144.922	mg	ME5	20.9	35	JMS	01/17/13	19:04	-0.037	QA Gross
12-T1824	148.322	mg	ME5	20.9	35	JMS	01/17/13	19:07	-13.687	QA Gross
12-T1825	147.547	mg	ME5	20.9	35	JMS	01/17/13	19:08	-1.421	QA Gross
12-T1827	144.456	mg	ME5	20.9	35	JMS	01/17/13	19:09	-0.630	QA Gross
12-T1828	145.605	mg	ME5	20.9	35	JMS	01/17/13	19:12	-0.576	QA Gross
Cal Check	100.003	mg	ME5	20.9	35	JMS	01/17/13	19:15		
Cal Check	0.000	mg	ME5	20.9	35	JMS	01/17/13	19:15		

200 mg: 199.999 ± 3 µg
100 mg: 100.003 ± 3 µg

Printed 1/17/13 at 20:01
Filename: 121222MG.xls

Filbert Log File

Filter	Mass	Units	Balance	Temp.	Hum.	Initials	Date	Time	Net	Procedure
12-T1829	145.914	mg	ME5	20.9	35	JMS	01/17/13	19:18	-2.307	QA Gross
12-T1830	153.994	mg	ME5	20.9	35	JMS	01/17/13	19:21	-3.850	QA Gross
12-T1831	149.250	mg	ME5	20.9	35	JMS	01/17/13	19:24	-4.902	QA Gross
12-T1832	143.232	mg	ME5	20.9	35	JMS	01/17/13	19:25	-1.229	QA Gross
12-T1833	146.818	mg	ME5	20.9	35	JMS	01/17/13	19:27	-2.216	QA Gross
12-T1834	143.984	mg	ME5	20.9	35	JMS	01/17/13	19:29	-1.146	QA Gross
12-T1835	147.406	mg	ME5	20.9	35	JMS	01/17/13	19:31	-5.306	QA Gross
12-T1836	146.237	mg	ME5	20.9	35	JMS	01/17/13	19:33	-2.939	QA Gross
~~12-T1837~~	~~0.000~~	~~mg~~	~~ME5~~	~~20.9~~	~~35~~	~~JMS~~	~~01/17/13~~	~~19:33~~	~~-153.141~~	~~QA Gross~~
12-T1837	149.656	mg	ME5	20.9	35	JMS	01/17/13	19:35	-3.485	QA Gross
Cal Check	199.998	mg	ME5	20.9	35	JMS	01/17/13	19:38		
Cal Check	0.000	mg	ME5	20.9	35	JMS	01/17/13	19:38		
12-T1840	142.233	mg	ME5	20.9	35	JMS	01/17/13	19:40	-0.724	QA Gross
12-T1841	146.214	mg	ME5	20.9	35	JMS	01/17/13	19:42	-4.688	QA Gross
12-T1842	145.514	mg	ME5	20.9	35	JMS	01/17/13	19:45	-1.557	QA Gross
12-T1843	141.792	mg	ME5	20.9	35	JMS	01/17/13	19:46	-1.171	QA Gross
12-T1844	147.124	mg	ME5	20.9	35	JMS	01/17/13	19:49	-0.554	QA Gross
12-T1847	147.881	mg	ME5	20.9	35	JMS	01/17/13	19:51	-1.587	QA Gross
12-T1850	144.272	mg	ME5	20.9	35	JMS	01/17/13	19:53	-1.228	QA Gross
12-T1851	143.887	mg	ME5	20.9	35	JMS	01/17/13	19:56	-0.702	QA Gross
12-T1853	147.840	mg	ME5	20.9	35	JMS	01/17/13	19:57	-0.475	QA Gross
Cal Check	100.005	mg	ME5	20.9	35	JMS	01/17/13	19:59		
Cal Check	199.997	mg	ME5	20.9	35	JMS	01/17/13	20:00		
Cal Check	0.000	mg	ME5	20.9	35	JMS	01/17/13	20:01		

200 mg: 199.999 ± 3 µg
100 mg: 100.003 ± 3 µg

Printed 1/17/13 at 20:01
Filename: 121222MG.xls

CHESTER LabNet

XRF-772 **XRF Analytical Quality Assurance Report**

Client: Arcadis
Report: 12-568
Analysis Period: January 9 through 11, 2013
Number of Samples: 38

1. Precision Data

Micromatter Multi-elemental Quality Control Standard: QS285

QC Standard Results

Analyte	n	Counts per Second			c.v.	%E
		Calib.	Meas.	S.D.		
Si(0)	4	1838.16	1821.93	14.33	0.79	-0.88
Ti(1)	4	479.85	479.74	2.05	0.43	-0.02
Fe(1)	4	1188.98	1189.00	11.23	0.94	0.00
Se(3)	4	374.39	374.01	2.27	0.61	-0.10
Pb(3)	4	435.25	434.38	3.29	0.76	-0.20
Cd(4)	4	138.65	138.35	1.26	0.91	-0.22

2. Accuracy Data

NIST Standard Reference Materials: SRM 1832, SRM 1833, SRM 2783

Analyte/ SRM	n	Certified Value(µg/cm²)	Measured Value (µg/cm²)			% Rec.
			High	Low	Average	
Al 1832	4	14.6 +/- .97	15.02	14.53	14.89 +/- 0.21	102.0
Si 1832	4	34.0 +/- 1.1	36.13	35.87	36.03 +/- 0.10	106.0
Si 1833	4	31.5 +/- 2.1	32.36	31.46	32.01 +/- 0.33	101.6
S 2708	4	2.46 +/- .25	2.45	2.35	2.39 +/- 0.04	97.0
K 1833	4	16.4 +/- 1.64	17.46	17.12	17.26 +/- 0.13	105.3
Ca 2783	4	1.33 +/- 0.17	1.32	1.28	1.30 +/- 0.02	97.8
Ti 1833	4	12.1 +/- 1.79	12.07	11.81	11.93 +/- 0.09	98.6
V 1832	4	4.70 +/- .49	4.62	4.56	4.59 +/- 0.02	97.6
Mn 1832	4	4.54 +/- .49	4.73	4.62	4.68 +/- 0.05	103.1
Fe 1833	4	13.6 +/- .45	13.17	13.03	13.10 +/- 0.05	96.3
Cu 1832	4	2.43 +/- .16	2.48	2.46	2.47 +/- 0.01	101.5
Zn 2783	4	.180 +/- .013	0.18	0.18	0.18 +/- 0.00	101.2
Pb 1833	4	16.1 +/- .75	16.17	15.88	16.02 +/- 0.10	99.5

NIST: National Institute of Standards and Technology
% Rec: Percent Recovery = (Experimental/Given) x 100
n: Number of Observations
S.D.: Standard Deviation
c.v.: Coefficient of Variation = (S.D./Measured) x 100
% E: Percent Error = [(Measured-Calibrated)/Calibrated] x 100

XRF-772 REPLICATE REPORT

5.45

Original ID: 12-T1806

Replicate ID: RT1806

Filter Lot:

Deposit Mass: 8739 µg

Deposit Area: 11.3 cm²

Particle Size: F

Element	Original ug/cm2			Replicate ug/cm2			Difference ug/cm2			RPD		
Na	0.0000	+-	6.5895	0.0000	+-	1.4388	0.0000	+-	6.7448			
Mg	2.0348	+-	1.4299	1.4697	+-	0.6813	0.5651	+-	1.5839			
Al	15.5016	+-	2.1727	15.3801	+-	2.1396	0.1214	+-	3.0494	+	0.8	+- 19.7
Si	133.7194	+-	13.9099	134.0551	+-	13.8664	-0.3357	+-	19.6408	+	-0.3	+- 14.7
P	0.2371	+-	0.0384	0.2513	+-	0.0393	-0.0142	+-	0.0549	+	-5.8	+- 22.5
S	0.0872	+-	0.0205	0.0759	+-	0.0203	0.0113	+-	0.0289	+	13.9	+- 35.5
Cl	0.0582	+-	0.0175	0.0570	+-	0.0176	0.0012	+-	0.0248	+	2.0	+- 43.1
K	7.0907	+-	0.3964	7.0646	+-	0.3947	0.0261	+-	0.5594	+	0.4	+- 7.9
Ca	10.9200	+-	0.5950	10.8870	+-	0.5929	0.0331	+-	0.8399	+	0.3	+- 7.7
Ti	0.7300	+-	0.0379	0.7358	+-	0.0381	-0.0058	+-	0.0537	+	-0.8	+- 7.3
V	0.0317	+-	0.0045	0.0335	+-	0.0045	-0.0018	+-	0.0063	+	-5.5	+- 19.5
Cr	0.0274	+-	0.0028	0.0258	+-	0.0028	0.0016	+-	0.0039	+	6.2	+- 14.8
Mn	0.1387	+-	0.0076	0.1519	+-	0.0082	-0.0133	+-	0.0112	0	-9.1	+- 7.7
Fe	7.3179	+-	0.3665	7.3022	+-	0.3658	0.0157	+-	0.5178	+	0.2	+- 7.1
Co	0.0000	+-	0.0028	0.0000	+-	0.0028	0.0000	+-	0.0040			
Ni	0.0028	+-	0.0012	0.0014	+-	0.0012	0.0013	+-	0.0017			
Cu	0.0275	+-	0.0031	0.0278	+-	0.0030	-0.0003	+-	0.0043	+	-1.1	+- 15.7
Zn	0.0187	+-	0.0015	0.0212	+-	0.0025	-0.0025	+-	0.0029	+	-12.6	+- 14.5
Ga	0.0038	+-	0.0010	0.0042	+-	0.0010	-0.0004	+-	0.0014	+	-10.3	+- 35.6
Ge	0.0024	+-	0.0009	0.0000	+-	0.0010	0.0024	+-	0.0014			
As	0.0039	+-	0.0014	0.0047	+-	0.0014	-0.0008	+-	0.0019			
Se	0.0003	+-	0.0007	0.0012	+-	0.0007	-0.0008	+-	0.0010			
Br	0.0038	+-	0.0007	0.0042	+-	0.0007	-0.0003	+-	0.0010	+	-8.6	+- 24.6
Rb	0.0323	+-	0.0019	0.0327	+-	0.0019	-0.0003	+-	0.0027	+	-1.1	+- 8.3
Sr	0.0813	+-	0.0043	0.0821	+-	0.0043	-0.0007	+-	0.0061	+	-0.9	+- 7.4
Y	0.0073	+-	0.0012	0.0088	+-	0.0012	-0.0015	+-	0.0017	+	-18.3	+- 21.4
Zr	0.0484	+-	0.0029	0.0453	+-	0.0028	0.0031	+-	0.0040	+	6.7	+- 8.5
Mo	0.0001	+-	0.0019	0.0000	+-	0.0019	0.0001	+-	0.0027			
Pd	0.0028	+-	0.0038	0.0000	+-	0.0039	0.0028	+-	0.0054			
Ag	0.0000	+-	0.0039	0.0000	+-	0.0038	0.0000	+-	0.0054			
Cd	0.0000	+-	0.0038	0.0000	+-	0.0039	0.0000	+-	0.0055			
In	0.0000	+-	0.0042	0.0000	+-	0.0042	0.0000	+-	0.0059			
Sn	0.0000	+-	0.0049	0.0000	+-	0.0050	0.0000	+-	0.0070			
Sb	0.0007	+-	0.0056	0.0070	+-	0.0056	-0.0063	+-	0.0079			
Ba	0.3025	+-	0.0256	0.2785	+-	0.0254	0.0240	+-	0.0361	+	8.3	+- 12.4
La	0.0000	+-	0.0208	0.0000	+-	0.0210	0.0000	+-	0.0295			
Hg	0.0000	+-	0.0021	0.0069	+-	0.0018	-0.0069	+-	0.0028			
Pb	0.0094	+-	0.0020	0.0119	+-	0.0021	-0.0026	+-	0.0029	+	-24.4	+- 27.3

RPD: Relative Percent Difference (X1-X2)/[(X1+X2)/2]*100. RPD is calculated when original value is greater than three times its uncertainty.

XRF-772 REPLICATE REPORT

4.50

Original ID: 12-T1822

Replicate ID: RT1822

Filter Lot:

Deposit Mass: 4144 µg

Deposit Area: 11.3 cm²

Particle Size: F

Element	Original ug/cm2			Replicate ug/cm2			Difference ug/cm2			RPD		
Na	0.0000	+-	1.5234	0.0000	+-	0.3853	0.0000	+-	1.5714			
Mg	0.8187	+-	0.3927	0.7134	+-	0.2333	0.1053	+-	0.4568			
Al	8.1256	+-	0.8048	7.9278	+-	0.7812	0.1979	+-	1.1216	+ 2.5	+-	14.0
Si	66.8976	+-	5.2158	66.6896	+-	5.1775	0.2081	+-	7.3492	+ 0.3	+-	11.0
P	0.0883	+-	0.0156	0.0909	+-	0.0155	-0.0026	+-	0.0220	+ -2.9	+-	24.6
S	0.0398	+-	0.0136	0.0697	+-	0.0141	-0.0299	+-	0.0196			
Cl	0.0855	+-	0.0106	0.0976	+-	0.0109	-0.0121	+-	0.0152	+ -13.3	+-	16.6
K	3.0827	+-	0.1645	3.0975	+-	0.1652	-0.0148	+-	0.2332	+ -0.5	+-	7.5
Ca	4.2616	+-	0.2238	4.2566	+-	0.2234	0.0050	+-	0.3162	+ 0.1	+-	7.4
Ti	0.3232	+-	0.0172	0.3216	+-	0.0171	0.0016	+-	0.0243	+ 0.5	+-	7.5
V	0.0092	+-	0.0024	0.0076	+-	0.0024	0.0016	+-	0.0034	+ 19.0	+-	40.6
Cr	0.0097	+-	0.0015	0.0084	+-	0.0015	0.0012	+-	0.0021	+ 13.7	+-	23.3
Mn	0.0644	+-	0.0038	0.0607	+-	0.0037	0.0036	+-	0.0053	+ 5.8	+-	8.5
Fe	3.4999	+-	0.1756	3.4693	+-	0.1741	0.0306	+-	0.2473	+ 0.9	+-	7.1
Co	0.0000	+-	0.0019	0.0000	+-	0.0019	0.0000	+-	0.0027			
Ni	0.0000	+-	0.0007	0.0004	+-	0.0008	-0.0004	+-	0.0010			
Cu	0.0071	+-	0.0009	0.0087	+-	0.0009	-0.0016	+-	0.0013	0 -20.6	+-	16.1
Zn	0.0095	+-	0.0010	0.0095	+-	0.0010	0.0001	+-	0.0014	+ 0.6	+-	15.1
Ga	0.0031	+-	0.0007	0.0020	+-	0.0007	0.0011	+-	0.0011	0 42.4	+-	41.5
Ge	0.0013	+-	0.0007	0.0007	+-	0.0007	0.0007	+-	0.0009			
As	0.0013	+-	0.0010	0.0013	+-	0.0010	0.0000	+-	0.0014			
Se	0.0000	+-	0.0006	0.0000	+-	0.0006	0.0000	+-	0.0008			
Br	0.0183	+-	0.0011	0.0172	+-	0.0011	0.0012	+-	0.0016	+ 6.6	+-	8.9
Rb	0.0134	+-	0.0010	0.0136	+-	0.0010	-0.0002	+-	0.0014	+ -1.5	+-	10.2
Sr	0.0299	+-	0.0017	0.0305	+-	0.0018	-0.0005	+-	0.0025	+ -1.7	+-	8.2
Y	0.0000	+-	0.0009	0.0037	+-	0.0009	-0.0037	+-	0.0013			
Zr	0.0264	+-	0.0018	0.0287	+-	0.0019	-0.0023	+-	0.0026	+ -8.3	+-	9.4
Mo	0.0000	+-	0.0015	0.0000	+-	0.0016	0.0000	+-	0.0022			
Pd	0.0000	+-	0.0033	0.0000	+-	0.0032	0.0000	+-	0.0046			
Ag	0.0000	+-	0.0033	0.0000	+-	0.0033	0.0000	+-	0.0046			
Cd	0.0690	+-	0.0053	0.0671	+-	0.0052	0.0019	+-	0.0074	+ 2.8	+-	10.9
In	0.0000	+-	0.0036	0.0000	+-	0.0037	0.0000	+-	0.0052			
Sn	0.0000	+-	0.0043	0.0000	+-	0.0044	0.0000	+-	0.0062			
Sb	0.0000	+-	0.0052	0.0000	+-	0.0052	0.0000	+-	0.0073			
Ba	0.1472	+-	0.0118	0.1599	+-	0.0120	-0.0126	+-	0.0168	+ -8.2	+-	11.0
La	0.0120	+-	0.0103	0.0000	+-	0.0102	0.0120	+-	0.0145			
Hg	0.0000	+-	0.0015	0.0000	+-	0.0016	0.0000	+-	0.0022			
Pb	0.0037	+-	0.0015	0.0052	+-	0.0015	-0.0015	+-	0.0021			

RPD: Relative Percent Difference (X1-X2)/[(X1+X2)/2]*100. RPD is calculated when original value is greater than three times its uncertainty.

XRF-772 REPLICATE REPORT

4.86

Original ID: 12-T1841

Replicate ID: RT1841

Filter Lot:

Deposit Mass: 7857 µg

Deposit Area: 11.3 cm²

Particle Size: F

Element	Original ug/cm2			Replicate ug/cm2			Difference ug/cm2			RPD		
Na	1.7736	+-	2.7802	1.5603	+-	3.0283	0.2133	+-	4.1110			
Mg	2.4191	+-	0.8461	2.3523	+-	0.9099	0.0668	+-	1.2425			
Al	12.6572	+-	1.5691	12.5370	+-	1.5566	0.1202	+-	2.2102	+ 1.0	+-	17.5
Si	70.5424	+-	6.5902	71.0151	+-	6.6401	-0.4727	+-	9.3553	+ -0.7	+-	13.2
P	0.1475	+-	0.0222	0.1281	+-	0.0211	0.0194	+-	0.0306	+ 14.1	+-	22.2
S	0.0560	+-	0.0122	0.0789	+-	0.0129	-0.0229	+-	0.0177	0 -33.9	+-	26.3
Cl	0.0313	+-	0.0099	0.0433	+-	0.0104	-0.0120	+-	0.0144	+ -32.2	+-	38.7
K	4.2378	+-	0.2306	4.2023	+-	0.2287	0.0355	+-	0.3247	+ 0.8	+-	7.7
Ca	7.7935	+-	0.4151	7.6909	+-	0.4097	0.1026	+-	0.5832	+ 1.3	+-	7.5
Ti	0.4699	+-	0.0245	0.4699	+-	0.0245	0.0000	+-	0.0346	+ 0.0	+-	7.4
V	0.0133	+-	0.0029	0.0146	+-	0.0029	-0.0012	+-	0.0041	+ -8.7	+-	29.5
Cr	0.0551	+-	0.0050	0.0579	+-	0.0035	-0.0028	+-	0.0061	+ -4.9	+-	10.8
Mn	0.0996	+-	0.0056	0.1002	+-	0.0056	-0.0006	+-	0.0079	+ -0.6	+-	8.0
Fe	4.5793	+-	0.2296	4.6088	+-	0.2311	-0.0295	+-	0.3258	+ -0.6	+-	7.1
Co	0.0000	+-	0.0022	0.0000	+-	0.0022	0.0000	+-	0.0031			
Ni	0.0214	+-	0.0016	0.0218	+-	0.0016	-0.0004	+-	0.0023	+ -1.7	+-	10.6
Cu	0.0467	+-	0.0040	0.0452	+-	0.0039	0.0015	+-	0.0055	+ 3.2	+-	12.1
Zn	0.0355	+-	0.0032	0.0349	+-	0.0032	0.0006	+-	0.0045	+ 1.8	+-	12.8
Ga	0.0020	+-	0.0007	0.0018	+-	0.0007	0.0002	+-	0.0010			
Ge	0.0000	+-	0.0007	0.0017	+-	0.0006	-0.0017	+-	0.0010			
As	0.0029	+-	0.0010	0.0033	+-	0.0010	-0.0004	+-	0.0014			
Se	0.0007	+-	0.0005	0.0006	+-	0.0005	0.0001	+-	0.0007			
Br	0.0039	+-	0.0005	0.0032	+-	0.0005	0.0007	+-	0.0008	+ 19.2	+-	21.2
Rb	0.0211	+-	0.0013	0.0199	+-	0.0012	0.0011	+-	0.0018	+ 5.5	+-	8.6
Sr	0.0465	+-	0.0025	0.0467	+-	0.0025	-0.0002	+-	0.0035	+ -0.5	+-	7.6
Y	0.0040	+-	0.0008	0.0055	+-	0.0009	-0.0016	+-	0.0012	0 -33.4	+-	25.4
Zr	0.0247	+-	0.0016	0.0258	+-	0.0017	-0.0011	+-	0.0024	+ -4.5	+-	9.4
Mo	0.0000	+-	0.0014	0.0000	+-	0.0014	0.0000	+-	0.0020			
Pd	0.0018	+-	0.0032	0.0008	+-	0.0032	0.0009	+-	0.0045			
Ag	0.0000	+-	0.0033	0.0000	+-	0.0033	0.0000	+-	0.0046			
Cd	0.0000	+-	0.0032	0.0000	+-	0.0033	0.0000	+-	0.0046			
In	0.0000	+-	0.0036	0.0000	+-	0.0036	0.0000	+-	0.0050			
Sn	0.0153	+-	0.0046	0.0143	+-	0.0046	0.0011	+-	0.0065	+ 7.3	+-	43.7
Sb	0.0000	+-	0.0047	0.0000	+-	0.0048	0.0000	+-	0.0067			
Ba	0.1915	+-	0.0155	0.2073	+-	0.0157	-0.0159	+-	0.0221	+ -8.0	+-	11.1
La	0.0000	+-	0.0131	0.0000	+-	0.0132	0.0000	+-	0.0186			
Hg	0.0042	+-	0.0013	0.0000	+-	0.0015	0.0042	+-	0.0020			
Pb	0.0130	+-	0.0016	0.0127	+-	0.0016	0.0003	+-	0.0023	+ 2.2	+-	17.9

RPD: Relative Percent Difference (X1-X2)/[(X1+X2)/2]*100. RPD is calculated when original value is greater than three times its uncertainty.

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: filter
Report Number: 12-568

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Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
Al	ICB	< MDL	15.0
Al	Prep_Blk	27.1	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Ca	ICB	< MDL	5.00
Ca	Prep_Blk	24.0	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Fe	ICB	< MDL	2.00
Fe	Prep_Blk	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Hf	ICB	< MDL	2.00
Hf	Prep_Blk	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
K	ICB	< MDL	5.00
K	Prep_Blk	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	ICB	< MDL	5.00
K	CCB	< MDL	5.00
Mg	ICB	< MDL	2.00
Mg	Prep_Blk	3.25	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mn	ICB	< MDL	0.200
Mn	Prep_Blk	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Na	ICB	< MDL	12.0
Na	Prep_Blk	19.2	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Pb	ICB	< MDL	5.00
Pb	Prep_Blk	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Zr	ICB	< MDL	1.00
Zr	Prep_Blk	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00

*: Method Blank concentration in µg/filter

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: filter
Report Number: 12-568

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Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Al	ICV	2500	2510	100.4
Al	*CRI*	*75.0*	*74.1*	*98.8*
Al	CCV	2500	2520	100.9
Al	CCV	2500	2540	101.4
Al	CCV	2500	2520	100.8
Ca	ICV	1000	1010	101.4
Ca	*CRI*	*25.0*	*32.5*	*129.9*
Ca	CCV	1000	997.	99.7
Ca	CCV	1000	994.	99.4
Ca	CCV	1000	1000	100.1
Fe	ICV	1000	1050	104.6
Fe	*CRI*	*10.0*	*7.56*	*75.6*
Fe	CCV	1000	1040	104.4
Fe	CCV	1000	1040	103.9
Fe	CCV	1000	1040	104.2
Hf	ICV	1000	1020	101.5
Hf	*CRI*	*10.0*	*10.4*	*104.4*
Hf	CCV	1000	1020	101.8
Hf	CCV	1000	1010	101.4
Hf	CCV	1000	1020	101.8
K	ICV	2500	2420	96.8
K	*CRI*	*25.0*	*23.2*	*92.8*
K	CCV	2500	2500	100.2
K	CCV	2500	2430	97.2
K	CCV	2500	2420	96.7
K	ICV	2500	2350	94.2
K	*CRI*	*25.0*	*21.6*	*86.6*
K	CCV	2500	2360	94.5
Mg	ICV	1000	996.	99.6
Mg	*CRI*	*10.0*	*10.6*	*105.5*
Mg	CCV	1000	988.	98.8
Mg	CCV	1000	994.	99.4
Mg	CCV	1000	986.	98.6
Mn	ICV	1000	992.	99.2
Mn	*CRI*	*1.00*	*1.09*	*109.0*
Mn	CCV	1000	1000	100.2
Mn	CCV	1000	1000	100.1
Mn	CCV	1000	998.	99.8
Na	ICV	2500	2290	91.6
Na	*CRI*	*60.0*	*49.3*	*82.1*
Na	CCV	2500	2320	92.8
Na	CCV	2500	2310	92.6
Na	CCV	2500	2290	91.4
Pb	ICV	1000	1000	100.3
Pb	*CRI*	*25.0*	*24.7*	*98.8*
Pb	CCV	1000	1010	100.6
Pb	CCV	1000	1010	100.6
Pb	CCV	1000	996.	99.6
Zr	ICV	1000	982.	98.2
Zr	*CRI*	*5.00*	*4.86*	*97.2*
Zr	CCV	1000	1000	100.1
Zr	CCV	1000	996.	99.6
Zr	CCV	1000	992.	99.2

CRI Limits: 20% - 200% Recovery

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: filter
Report Number: 12-568

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Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Al	12-X1607	992.0	998.0	0.60
Ca	12-X1607	3140.	3148.	0.25
Fe	12-X1607	1092.	1078.	1.29
Hf	12-X1607	< 2	< 2	N/C #
K	12-X1607	278.9	296.3	6.05
Mg	12-X1607	289.0	282.7	2.20
Mn	12-X1607	21.63	21.53	0.46
Na	12-X1607	155.0	156.8	1.15
Pb	12-X1607	11.50	12.08	4.92 #
Zr	12-X1607	2.486	2.885	14.9 #

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

Laboratory Control Sample/Matrix Post Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Al	LCS	27.1	1180	1000	116.
Al	12-X1608	1238.	2148.	1000.	91.0
Ca	LCS	24.0	1040	1000	102.
Ca	12-X1608	4202.	9015.	5000.	96.3
Fe	LCS	< 2	1000	1000	100.
Fe	12-X1608	1293.	2273.	1000.	98.0
Hf	LCS	< 2	956.	1000	95.6
Hf	12-X1608	< 2	994.1	1000.	99.4
K	LCS	< 5	1030	1000	103.
K	12-X1608	366.5	1444.	1000.	108.
Mg	LCS	3.25	984.	1000	98.1
Mg	12-X1608	385.9	1341.	1000.	95.5
Mn	LCS	< 0.2	992.	1000	99.2
Mn	12-X1608	26.33	977.0	1000.	95.1
Na	LCS	19.2	1080	1000	106.
Na	12-X1608	140.0	1162.	1000.	102.
Pb	LCS	< 5	977.	1000	97.7
Pb	12-X1608	12.97	937.0	1000.	92.4
Zr	LCS	< 1	945.	1000	94.5
Zr	12-X1608	2.679	968.1	1000.	96.5

Percent Recovery = (spike - sample)/spike amount*100
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

Chain of Custody/ Correspondence

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

Lab Work Order #

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-061612-01	061612		Comp B 3feet	PM2.5	12-T1302 P0219199	X	X									
PS-OD-PM2.5-061612-02	061612		Comp B 3feet	PM2.5	12-T1803 P0458953	X	X									
PS-OD-PM2.5-061612-03	061612		Comp B 3feet	PM2.5	12-T1804 P0458954	X	X									
PS-OD-PM2.5-061812-01	061812		Comp B 3feet	PM2.5	12-T1811 P0458961	X	X									
PS-OD-PM2.5-061912-01	061912		Warhead 6feet	PM2.5	12-T1812 P0458902	X	X									
BS-OD-PM2.5-062012	062012		Background	PM2.5	12-T1821 P0458971	X	X									
PS-OD-PM2.5-062112-02-OR	062112		Warhead 3feet	PM2.5	12-T1819 P0458969	X	X									
PS-OD-PM2.5-062112-03	062112		Warhead 3feet	PM2.5	12-T1820 P0458970	X	X									
PS-OD-PM2.5-062112-04-OR	062112		Warhead 3feet	PM2.5	12-T1825 P0458975	X	X									
PS-OD-PM2.5-062212-01-W1	062212		V548 3feet	PM2.5	12-T1828 P0458978	X	X									

Requested Analyses	
1	Weight
2	XRF + Hf
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	11/2012		[signature] 11-30-12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

Lab Work Order #

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-062312-02-OR	062312		Warhead 3feet	PM2.5	~~PS-OD-P~~ 12-T1831 P0458981	X	X									Ground
PS-OD-PM2.5-062312-01-	062312		V548 3 feet	PM2.5	12-T1824 P0458974	X	X									Ground
PS-OD-PM2.5-062512-01	062512		V548 3feet	PM2.5	12-T1833 P0458983	X	X									Ground
PS-OD-PM2.5-062512-02-OR	062512		V548 3feet	PM2.5	12-T1836 P0458986	X	X									Ground
PS-OD-PM2.5-062512-03	062512		V548 3feet	PM2.5	12-T1832 P0458982	X	X									Ground
PS-OD-PM2.5-062512-04-OR	062512		548 3feet	PM2.5	12-T1834 P0458984	X	X									Ground
PS-OD-PM2.5-062612-01	062612		V548 3feet	PM2.5	12-T1843 P0458993	X	X									
PS-OD-PM2.5-062712-01	062712		548 3feet	PM2.5	12-T1850 P0459000	X	X									
PS-OD-PM2.5-062812	062812		Ambient air	PM2.5	12-T1844 P0458994	X										

Requested Analyses	
1	Weight
2	XRF+HG
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11/30/12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

OD Tooele 2012

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10

Lab Work Order #

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10-0 061612-01	061612		Comp B 3 feet	PM10	12-T1806 P0458956	X	X									
PS-OD-PM10-0616 12-02	061612		Comp B 3 feet	10	12-T1810 P0458960	X	X									
PS-OD-PM10-661612-03	061612		Comp B 3 feet	10	12-T1809 P0458959	X	X									
PS-OD-PM10-061812-01	061812		Comp B 3 feet	10	12-T1814 P0458964	X	X									
PS-OD-PM10-06 1912-01	061912		Warhead 6 feet	10	12-T1817 P0458967	X	X									
BS-OD-PM10-062012-01	062012		Ambient	10	12-T1823 P0458973	X	X									
PS-OD-PM10-062112-02-OR	062112		Warhead 3 feet	10	12-T1822 P0458972	X	X									
PS-OD-PM10-062112-03	062112		Warhead 3 feet	10	12-T1816 P0458966	X	X									
PS-OD-PM10-062112-04-OR	062112		Warhead 3 feet	10	12-T1827 P0458977	X	X									
PS-OD-PM10-062212-01-W1	062212		V548 3 feet	10	12-T1829 P0458979	X	X									

Requested Analyses	
1	Weight
2	~~Cr~~ ~~XRF~~ ~~Hf~~ XRF+
3	~~Zr~~ Hf
4	~~Hf~~
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	1/2012		[signature] 11/30/12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10-062312-01	062312		V548 3feet	10	12-T1835 P0458985	X	X									Ground
PS-OD-PM10-062312-02-OR	062312		V548	10	12-T1830 P0458980	X	X									Ground
PS-OD-PM10-062512-01	062512		V548 3feet	10	12-T1837 P0458987	X	X									Ground
PS-OD-PM10-062512-02-OR	062512		V548 3feet	10	12-T1841 P0458991	X	X									Ground
PS-OD-PM10-062512-03	062512		V548 3feet	10	12-T1842 P0458992	X	X									Ground
PS-OD-PM10-062512-04-OR	062512		548 3feet	10	12-T1840 P0458990	X	X									
PS-OD-PM10-062612-01	062612		548 3feet	10	12-T1847 P0458997	X	X									
PS-OD-PM10-062712-01	062712		548 3feet	10	12-T1851 P0459651	X	X									
PS-OD-PM10-~~062812~~ 062812	062812		Ambient	10	12-T1853 P0460353	X										

Requested Analyses	
1	Weight
2	XRF+Hf
3	
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11/30/12 L. Bell 17:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10 Imp. > PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
~~PM10imp.~~ - PS-OD-PM10imp-061612-01	061612		Comp B 3feet	>10	JA99 ✓	X	X	X	X	X	X	X	X	X	X	12-X1607
PS-OD- PM10imp-061612-02	061612		Comp B 3feet	>10	JA104 ✓	X	X	X	X	X	X	X	X	X	X	X1608
PS-OD- PM10imp-061612-03	061612		Comp B 3feet	>10	JA102 ✓	X	X	X	X	X	X	X	X	X	X	X1609
PS-OD-PM10imp-061812-01	061812		Comp B 3feet	>10	JA107 ✓	X	X	X	X	X	X	X	X	X	X	X1610
PS-OD- PM10imp-061912-01	061912		Warhead 6feet	>10	JA110 ✓	X	X	X	X	X	X	X	X	X	X	X1611
PS-OD- PM10imp-062012-01	062012		Ambient	>10	JA116 ✓	X	X	X	X	X	X	X	X	X	X	X1612
PS-OD-PM10imp-062112-02-OR	062112		Warhead 3feet	>10	JA115 ✓	X	X	X	X	X	X	X	X	X	X	X1613
PS-OD-PM10imp.-062112-03	062112		Warhead 3feet	>10	JA109 ✓	X	X	X	X	X	X	X	X	X	X	X1614
PS-OD-PM10imp-062112-04-OR	062112		Warhead 3feet	>10	JA120 ✓	X	X	X	X	X	X	X	X	X	X	X1615
PS-OD-PM10 imp.-062212-01-W1	062212		548 3feet	>10	JA125 ✓	X	X	X	X	X	X	X	X	X	X	X1616

Requested Analyses	
1	~~XRF - Hf~~ ICP 96
2	Zr - 8. Na -
3	Mn - 9. Mg -
4	Al - 10. K -
5	Fe -
6	Hf -
7	Ca -

Special Instructions/Comments:

Add loose particles in the petri dish to the filter for XRF

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
Glenn Bell	112012		Liz Bell 11-20-12 13:45				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10 Imp. ? PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10Imp-062312-01	062312		548 3feet	710	JA123	X	X	X	X	X	X	X	X	X	X	Ground x1617
PS-OD-PM10Imp.-062312-02-OR	062312		548 3feet	710	JA 126	X	X	X	X	X	X	X	X	X	X	Ground x1618
PS-OD-PM10Imp-062512-01	062512		548 3feet	710	JA 130	X	X	X	X	X	X	X	X	X	X	Ground x1619
PS-OD-PM10Imp-062512-02-OR	062512		548 3feet	710	JA 134	X	X	X	X	X	X	X	X	X	X	Ground x1620
PS-OD-PM10Imp-062512-03	062512		548 3feet	710	JA 135	X	X	X	X	X	X	X	X	X	X	Ground x1621
PS-OD-PM10Imp.-062512-04-OR	062512		548 3feet	710	JA 133	X	X	X	X	X	X	X	X	X	X	Ground x1622
PS-OD-PM10Imp.-062612-01	062612		548 3feet	710	JA141	X	X	X	X	X	X	X	X	X	X	x1623
PS-OD-PM10Imp.-062712-01	062712		548 3feet	710	JA145	X	X	X	X	X	X	X	X	X	X	x1624

Requested Analyses	
1	~~XRF + HF~~ ICP Pb
2	Zr 8, Na
3	Mn 9, Mg
4	Al 10. K
5	Fe
6	Hf
7	Ca

Special Instructions/Comments:

Include loose particles for XRF

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
			11-20-12 Lisa Bell 13:45				
Relinquished by:	**DATE**	**TIME**	**Received by:**	**Relinquished by:**	**DATE**	**TIME**	**Received by:**

Raw Data/Calculations

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

RAW DATA

Available upon request

Report #2

ARCADIS

CLIENT # A053
REPORT # 12-376

SUBMITTED BY:
CHESTER LabNet
12242 S.W. GARDEN PLACE
TIGARD, OR 97223
(503)624-2183/FAX (503)624-2653
www.ChesterLab.Net

CHESTER LabNet

12242 SW Garden Place ❖ Tigard, OR 97223-8246 ❖ USA
Telephone 503-624-2183 ❖ Fax 503-624-2653 ❖ www.chesterlab.net

Case Narrative

Date: September 17, 2012

General Information

Client:	Arcadis
Client Number:	A053
Report Number:	12-376
Sample Description:	47mm Teflon filters, 47mm Polycarbonate filters, Soil

Analysis

Analytes:	Particulate Mass, XRF Metals (Na – Pb), Al, Ca, Fe, Hf, K, Mg, Mn, Na, Pb, Zr
Analytical Protocols:	Gravimetry Digestion: IO-3.1, X-Ray Fluorescence: IO-3.3, ICP: IO-3.4
Analytical Notes:	The Teflon LCS recoveries for Al and Na were slightly higher than the control limit. The Polycarbonate LCS recovery for Ca was low, possibly because of variations in the Ca background in the filter matrix itself since the Ca measured in the blank was at a very high concentration. Redigestion was not possible for the filters because the entire samples were digested. The Na matrix spike recovery for the soils was outside the control limits, most likely because of a non-homogenous sample. Results have **not** been blank corrected.
QA/QC Review:	All of the data have been reviewed by the analysts performing the analyses and the project manager. All of the quality control and sample-specific information in this package is complete and meets or exceeds the minimum requirements for acceptability.
Comments:	If you have any questions or concerns regarding this analysis, please feel free to contact the project manager.
Disclaimer:	This report shall not be reproduced, except in full, without the written approval of the laboratory. The results only represent that of the samples as received into the laboratory.

Paul Duda 9/17/12

Project Manager Date
Paul Duda

Data Summary

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1805
Client ID: PS-OD-PM10-061312
Filter ID: P0458955
Sample Date: 6/13/12 - 6/14/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	590.	±	10.			
XRF						
Na	9.023	±	1.251	1.529	±	0.2136
Mg	5.836	±	0.6023	0.9892	±	0.1035
Al	10.66	±	0.7707	1.807	±	0.1342
Si	102.3	±	5.901	17.34	±	1.042
* P	0.0000	±	0.0497	0.0000	±	0.0084
* S	0.0000	±	0.0316	0.0000	±	0.0054
* Cl	0.0475	±	0.0407	0.0080	±	0.0069
K	4.506	±	0.2384	0.7638	±	0.0424
Ca	11.28	±	0.5763	1.913	±	0.1029
Ti	0.5401	±	0.0316	0.0915	±	0.0056
V	0.0328	±	0.0090	0.0056	±	0.0015
* Cr	0.0170	±	0.0079	0.0029	±	0.0013
Mn	0.0802	±	0.0136	0.0136	±	0.0023
Fe	4.784	±	0.2452	0.8109	±	0.0438
* Co	0.0045	±	0.0102	0.0008	±	0.0017
* Ni	0.0000	±	0.0068	0.0000	±	0.0011
* Cu	0.0000	±	0.0068	0.0000	±	0.0011
Zn	0.0226	±	0.0068	0.0038	±	0.0012
* Ga	0.0000	±	0.0113	0.0000	±	0.0019
* Ge	0.0170	±	0.0102	0.0029	±	0.0017
* As	0.0000	±	0.0147	0.0000	±	0.0025
* Se	0.0226	±	0.0079	0.0038	±	0.0013
* Br	0.0136	±	0.0079	0.0023	±	0.0013
Rb	0.0282	±	0.0079	0.0048	±	0.0013
Sr	0.0644	±	0.0102	0.0109	±	0.0017
* Y	0.0034	±	0.0113	0.0006	±	0.0019
* Zr	0.0362	±	0.0136	0.0061	±	0.0023
* Mo	0.0011	±	0.0192	0.0002	±	0.0033
* Pd	0.0000	±	0.0452	0.0000	±	0.0077
* Ag	0.0000	±	0.0452	0.0000	±	0.0077
* Cd	0.0000	±	0.0463	0.0000	±	0.0079
* In	0.0000	±	0.0497	0.0000	±	0.0084
* Sn	0.0000	±	0.0554	0.0000	±	0.0094
* Sb	0.0644	±	0.0689	0.0109	±	0.0117
* Ba	0.0486	±	0.0520	0.0082	±	0.0088
* La	0.0000	±	0.0452	0.0000	±	0.0077
* Hf	0.0554	±	0.0441	0.0094	±	0.0075
* Hg	0.0000	±	0.0237	0.0000	±	0.0040
* Pb	0.0294	±	0.0215	0.0050	±	0.0036

ICP	Conc.	MDL	Conc.	MDL
Al	10.89	0.750	1.846	0.1309
Ca	15.11	0.250	2.561	0.0607
Fe	5.420	0.100	0.9186	0.0230
Hf	< MDL	0.100	< MDL	0.0169
K	2.282	0.250	0.3867	0.0429
Mg	2.200	0.100	0.3728	0.0181
Mn	0.149	0.010	0.0252	0.0017
Na	2.633	0.600	0.4463	0.1020
Pb	< MDL	0.250	< MDL	0.0424
Zr	< MDL	0.050	< MDL	0.0085

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1852
Client ID: PS-OD-PM10-062712-02
Filter ID: P0460352
Sample Date: 6/27/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	679.	±	10.			
XRF						
Na	8.070	±	1.217	1.189	±	0.1801
Mg	5.160	±	0.5639	0.7599	±	0.0838
Al	11.86	±	0.8475	1.747	±	0.1274
Si	68.81	±	3.982	10.13	±	0.6052
* P	0.0000	±	0.0429	0.0000	±	0.0063
* S	0.0452	±	0.0305	0.0067	±	0.0045
Cl	0.2102	±	0.0463	0.0310	±	0.0068
K	4.606	±	0.2441	0.6783	±	0.0373
Ca	8.399	±	0.4305	1.237	±	0.0660
Ti	0.5887	±	0.0339	0.0867	±	0.0052
* V	0.0090	±	0.0090	0.0013	±	0.0013
Cr	0.0260	±	0.0079	0.0038	±	0.0012
Mn	0.1322	±	0.0147	0.0195	±	0.0022
Fe	5.975	±	0.3051	0.8800	±	0.0468
* Co	0.0000	±	0.0102	0.0000	±	0.0015
* Ni	0.0124	±	0.0068	0.0018	±	0.0010
* Cu	0.0000	±	0.0068	0.0000	±	0.0010
* Zn	0.0034	±	0.0068	0.0005	±	0.0010
Ga	0.0429	±	0.0124	0.0063	±	0.0018
* Ge	0.0192	±	0.0102	0.0028	±	0.0015
* As	0.0000	±	0.0147	0.0000	±	0.0022
* Se	0.0056	±	0.0079	0.0008	±	0.0012
Br	0.0260	±	0.0079	0.0038	±	0.0012
* Rb	0.0102	±	0.0079	0.0015	±	0.0012
Sr	0.0520	±	0.0102	0.0077	±	0.0015
* Y	0.0282	±	0.0113	0.0042	±	0.0017
* Zr	0.0373	±	0.0136	0.0055	±	0.0020
* Mo	0.0000	±	0.0192	0.0000	±	0.0028
* Pd	0.0000	±	0.0463	0.0000	±	0.0068
* Ag	0.0000	±	0.0463	0.0000	±	0.0068
* Cd	0.0588	±	0.0463	0.0087	±	0.0068
* In	0.0000	±	0.0497	0.0000	±	0.0073
* Sn	0.0000	±	0.0554	0.0000	±	0.0082
* Sb	0.0192	±	0.0701	0.0028	±	0.0103
* Ba	0.0000	±	0.0531	0.0000	±	0.0078
* La	0.0203	±	0.0396	0.0030	±	0.0058
* Hf	0.0011	±	0.0441	0.0002	±	0.0065
* Hg	0.0000	±	0.0237	0.0000	±	0.0035
* Pb	0.0271	±	0.0226	0.0040	±	0.0033

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1807
Client ID: PS-OD-PM10-061412
Filter ID: P0458957
Sample Date: 6/14/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	3,759.	±	10.			
XRF						
Na	10.50	±	2.504	0.2794	±	0.0666
Mg	6.560	±	0.9379	0.1745	±	0.0250
Al	10.69	±	0.9481	0.2844	±	0.0252
Si	73.53	±	4.852	1.956	±	0.1292
* P	0.0000	±	0.0463	0.0000	±	0.0012
* S	0.0000	±	0.0350	0.0000	±	0.0009
* Cl	0.0000	±	0.0396	0.0000	±	0.0011
K	4.041	±	0.2192	0.1075	±	0.0058
Ca	6.346	±	0.3311	0.1688	±	0.0088
Ti	0.4723	±	0.0282	0.0126	±	0.0008
* V	0.0056	±	0.0079	0.0002	±	0.0002
* Cr	0.0023	±	0.0079	0.0001	±	0.0002
Mn	0.0893	±	0.0124	0.0024	±	0.0003
Fe	4.153	±	0.2136	0.1105	±	0.0057
* Co	0.0000	±	0.0090	0.0000	±	0.0002
* Ni	0.0000	±	0.0068	0.0000	±	0.0002
* Cu	0.0147	±	0.0079	0.0004	±	0.0002
Zn	0.0203	±	0.0068	0.0005	±	0.0002
* Ga	0.0079	±	0.0102	0.0002	±	0.0003
* Ge	0.0192	±	0.0102	0.0005	±	0.0003
* As	0.0000	±	0.0136	0.0000	±	0.0004
* Se	0.0045	±	0.0079	0.0001	±	0.0002
* Br	0.0181	±	0.0068	0.0005	±	0.0002
Rb	0.0384	±	0.0079	0.0010	±	0.0002
Sr	0.0463	±	0.0090	0.0012	±	0.0002
* Y	0.0136	±	0.0102	0.0004	±	0.0003
* Zr	0.0124	±	0.0124	0.0003	±	0.0003
* Mo	0.0396	±	0.0181	0.0011	±	0.0005
* Pd	0.0316	±	0.0441	0.0008	±	0.0012
* Ag	0.0000	±	0.0441	0.0000	±	0.0012
* Cd	0.0000	±	0.0441	0.0000	±	0.0012
* In	0.0000	±	0.0475	0.0000	±	0.0013
* Sn	0.0000	±	0.0531	0.0000	±	0.0014
* Sb	0.0463	±	0.0655	0.0012	±	0.0017
* Ba	0.0237	±	0.0463	0.0006	±	0.0012
* La	0.0000	±	0.0362	0.0000	±	0.0010
* Hf	0.0000	±	0.0407	0.0000	±	0.0011
* Hg	0.0000	±	0.0226	0.0000	±	0.0006
* Pb	0.0316	±	0.0203	0.0008	±	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1808
Client ID: PS-OD-PM10-061512
Filter ID: P0458958
Sample Date: 6/15/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	9,275.	±	10.			
XRF						
* Na	0.0000	±	14.79	0.0000	±	0.1595
* Mg	12.90	±	8.005	0.1391	±	0.0863
Al	155.7	±	18.63	1.679	±	0.2009
Si	1296.	±	114.2	13.97	±	1.232
* P	0.0000	±	0.6057	0.0000	±	0.0065
* S	0.5085	±	0.2045	0.0055	±	0.0022
* Cl	0.3130	±	0.1356	0.0034	±	0.0015
K	56.88	±	4.479	0.6133	±	0.0483
Ca	92.33	±	4.981	0.9955	±	0.0537
Ti	6.234	±	0.3243	0.0672	±	0.0035
V	0.3266	±	0.0418	0.0035	±	0.0005
Cr	0.1831	±	0.0215	0.0020	±	0.0002
Mn	0.8882	±	0.0520	0.0096	±	0.0006
Fe	53.88	±	2.701	0.5809	±	0.0291
* Co	0.0000	±	0.0282	0.0000	±	0.0003
* Ni	0.0147	±	0.0136	0.0002	±	0.0001
Cu	0.1797	±	0.0170	0.0019	±	0.0002
Zn	0.1040	±	0.0113	0.0011	±	0.0001
* Ga	0.0418	±	0.0147	0.0005	±	0.0002
* Ge	0.0362	±	0.0124	0.0004	±	0.0001
* As	0.0000	±	0.0181	0.0000	±	0.0002
* Se	0.0023	±	0.0102	0.0000	±	0.0001
Br	0.0407	±	0.0090	0.0004	±	0.0001
Rb	0.2576	±	0.0170	0.0028	±	0.0002
Sr	0.7390	±	0.0396	0.0080	±	0.0004
Y	0.0554	±	0.0136	0.0006	±	0.0001
Zr	0.4294	±	0.0271	0.0046	±	0.0003
* Mo	0.0000	±	0.0215	0.0000	±	0.0002
* Pd	0.1435	±	0.0599	0.0015	±	0.0006
* Ag	0.0000	±	0.0588	0.0000	±	0.0006
* Cd	0.0000	±	0.0599	0.0000	±	0.0006
* In	0.0373	±	0.0644	0.0004	±	0.0007
* Sn	0.0000	±	0.0712	0.0000	±	0.0008
* Sb	0.0429	±	0.0893	0.0005	±	0.0010
Ba	1.938	±	0.2904	0.0209	±	0.0031
* La	0.0000	±	0.2237	0.0000	±	0.0024
* Hf	0.0000	±	0.0531	0.0000	±	0.0006
* Hg	0.0000	±	0.0282	0.0000	±	0.0003
Pb	0.0949	±	0.0271	0.0010	±	0.0003

ICP	Conc.	MDL	Conc.	MDL
Al	69.80	0.750	0.7526	0.0081
Ca	96.55	0.250	1.041	0.0029
Fe	55.85	0.100	0.6022	0.0013
Hf	< MDL	0.100	< MDL	0.0011
K	17.74	0.250	0.1912	0.0027
Mg	16.04	0.100	0.1729	0.0011
Mn	1.246	0.010	0.0134	0.0001
Na	4.934	0.600	0.0532	0.0065
Pb	< MDL	0.250	< MDL	0.0027
Zr	0.110	0.050	0.0012	0.0005

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1815
Client ID: PS-OD-PM10-061812-02
Filter ID: P0458965
Sample Date: 6/18/12 - 6/19/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	2,075.	±	10.			
XRF						
* Na	0.0000	±	0.8916	0.0000	±	0.0430
Mg	3.162	±	0.8215	0.1524	±	0.0396
Al	33.64	±	2.529	1.621	±	0.1221
Si	222.4	±	13.82	10.72	±	0.6680
* P	0.0000	±	0.0870	0.0000	±	0.0042
* S	0.0599	±	0.0746	0.0029	±	0.0036
Cl	0.6113	±	0.0667	0.0295	±	0.0032
K	10.83	±	0.8272	0.5220	±	0.0399
Ca	17.36	±	1.274	0.8365	±	0.0615
Ti	1.389	±	0.0734	0.0669	±	0.0036
V	0.0373	±	0.0113	0.0018	±	0.0005
* Cr	0.0181	±	0.0090	0.0009	±	0.0004
Mn	0.2102	±	0.0181	0.0101	±	0.0009
Fe	14.03	±	0.7085	0.6764	±	0.0343
* Co	0.0000	±	0.0147	0.0000	±	0.0007
* Ni	0.0000	±	0.0079	0.0000	±	0.0004
* Cu	0.0000	±	0.0079	0.0000	±	0.0004
Zn	0.0384	±	0.0079	0.0019	±	0.0004
* Ga	0.0192	±	0.0113	0.0009	±	0.0005
* Ge	0.0124	±	0.0102	0.0006	±	0.0005
* As	0.0000	±	0.0147	0.0000	±	0.0007
* Se	0.0113	±	0.0079	0.0005	±	0.0004
Br	0.2316	±	0.0158	0.0112	±	0.0008
Rb	0.0497	±	0.0090	0.0024	±	0.0004
Sr	0.1322	±	0.0124	0.0064	±	0.0006
* Y	0.0203	±	0.0113	0.0010	±	0.0005
Zr	0.0622	±	0.0136	0.0030	±	0.0007
* Mo	0.0000	±	0.0192	0.0000	±	0.0009
* Pd	0.0000	±	0.0475	0.0000	±	0.0023
* Ag	0.0000	±	0.0475	0.0000	±	0.0023
Cd	0.5820	±	0.0599	0.0280	±	0.0029
* In	0.0000	±	0.0508	0.0000	±	0.0025
* Sn	0.0000	±	0.0576	0.0000	±	0.0028
* Sb	0.0000	±	0.0712	0.0000	±	0.0034
* Ba	0.1571	±	0.0768	0.0076	±	0.0037
* La	0.0723	±	0.0531	0.0035	±	0.0026
* Hf	0.0203	±	0.0441	0.0010	±	0.0021
* Hg	0.0000	±	0.0237	0.0000	±	0.0011
* Pb	0.0181	±	0.0226	0.0009	±	0.0011

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1826
Client ID: PS-OD-PM10-062112-01
Filter ID: P0458976
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,573.	±	10.			
XRF						
* Na	0.0000	±	0.6859	0.0000	±	0.0436
Mg	2.326	±	0.6531	0.1478	±	0.0415
Al	20.58	±	1.524	1.308	±	0.0973
Si	190.0	±	11.49	12.08	±	0.7346
* P	0.0000	±	0.0701	0.0000	±	0.0045
* S	0.0011	±	0.0373	0.0001	±	0.0024
Cl	0.2294	±	0.0497	0.0146	±	0.0032
K	9.103	±	0.4746	0.5787	±	0.0304
Ca	11.88	±	0.6102	0.7550	±	0.0391
Ti	1.138	±	0.0610	0.0723	±	0.0039
V	0.0531	±	0.0113	0.0034	±	0.0007
* Cr	0.0000	±	0.0090	0.0000	±	0.0006
Mn	0.1672	±	0.0170	0.0106	±	0.0011
Fe	11.42	±	0.5774	0.7263	±	0.0370
* Co	0.0000	±	0.0136	0.0000	±	0.0009
* Ni	0.0000	±	0.0068	0.0000	±	0.0004
* Cu	0.0000	±	0.0079	0.0000	±	0.0005
* Zn	0.0192	±	0.0068	0.0012	±	0.0004
* Ga	0.0068	±	0.0113	0.0004	±	0.0007
* Ge	0.0181	±	0.0102	0.0011	±	0.0006
* As	0.0000	±	0.0147	0.0000	±	0.0009
* Se	0.0000	±	0.0079	0.0000	±	0.0005
Br	0.0859	±	0.0090	0.0055	±	0.0006
Rb	0.0373	±	0.0079	0.0024	±	0.0005
Sr	0.1017	±	0.0113	0.0065	±	0.0007
* Y	0.0170	±	0.0113	0.0011	±	0.0007
* Zr	0.0362	±	0.0136	0.0023	±	0.0009
* Mo	0.0181	±	0.0192	0.0011	±	0.0012
* Pd	0.0475	±	0.0463	0.0030	±	0.0029
* Ag	0.0000	±	0.0463	0.0000	±	0.0029
* Cd	0.0893	±	0.0486	0.0057	±	0.0031
* In	0.0294	±	0.0497	0.0019	±	0.0032
* Sn	0.0000	±	0.0554	0.0000	±	0.0035
* Sb	0.0249	±	0.0689	0.0016	±	0.0044
* Ba	0.1650	±	0.0689	0.0105	±	0.0044
* La	0.0000	±	0.0554	0.0000	±	0.0035
* Hf	0.1175	±	0.0441	0.0075	±	0.0028
* Hg	0.0000	±	0.0226	0.0000	±	0.0014
* Pb	0.0000	±	0.0215	0.0000	±	0.0014

ICP	Conc.	MDL	Conc.	MDL
Al	16.49	0.750	1.048	0.0481
Ca	15.12	0.250	0.9612	0.0170
Fe	12.16	0.100	0.7730	0.0080
Hf	< MDL	0.100	< MDL	0.0064
K	3.564	0.250	0.2265	0.0160
Mg	3.288	0.100	0.2090	0.0065
Mn	0.263	0.010	0.0167	0.0006
Na	2.094	0.600	0.1331	0.0382
Pb	< MDL	0.250	< MDL	0.0159
Zr	< MDL	0.050	< MDL	0.0032

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-X1215
Client ID: PS-OD-PM10 Imp-061312
Sample Date: 6/13/12 - 6/14/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	2.48	0.750
Ca	111.	0.250
Fe	1.86	0.100
Hf	< MDL	0.100
K	1.29	0.250
Mg	0.861	0.100
Mn	0.124	0.010
Na	4.25	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1216
Client ID: PS-OD-PM10 Imp-062712-02
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	3.16	0.750
Ca	128.	0.250
Fe	2.27	0.100
Hf	< MDL	0.100
K	1.73	0.250
Mg	0.986	0.100
Mn	0.135	0.010
Na	4.71	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1217
Client ID: PS-OD-PM10 Imp-061412
Sample Date: 6/14/12 - 6/15/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	17.2	0.750
Ca	93.0	0.250
Fe	15.6	0.100
Hf	< MDL	0.100
K	4.94	0.250
Mg	5.40	0.100
Mn	0.442	0.010
Na	3.91	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-X1218
Client ID: PS-OD-PM10 Imp-061512
Sample Date: 6/15/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	302.	0.750
Ca	556.	0.250
Fe	406.	0.100
Hf	< MDL	0.100
K	76.0	0.250
Mg	103.	0.100
Mn	7.34	0.010
Na	10.3	0.600
Pb	< MDL	0.250
Zr	0.364	0.050

Lab ID: 12-X1219
Client ID: PS-OD-PM10 Imp-0618-02
Sample Date: 6/18/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	14.6	0.750
Ca	177.	0.250
Fe	15.8	0.100
Hf	< MDL	0.100
K	3.94	0.250
Mg	4.33	0.100
Mn	0.390	0.010
Na	4.24	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1220
Client ID: PS-OD-PM10 Imp-062112-01
Sample Date: 6/21/12
Deposit Area: 9.62 cm²
Size Fraction: PM10

Analyte	µg/filter Conc.	MDL
ICP		
Al	4.20	0.750
Ca	161.	0.250
Fe	4.11	0.100
Hf	< MDL	0.100
K	1.41	0.250
Mg	1.19	0.100
Mn	0.166	0.010
Na	3.77	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1301
Client ID: PS-OD-PM2.5-061312
Filter ID: P0219198
Sample Date: 6/13/12 - 6/14/12
Filter Lot #: 45155
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,209.	±	10.			
XRF						
Na	6.323	±	1.353	0.5230	±	0.1120
Mg	5.070	±	0.6272	0.4194	±	0.0520
Al	10.88	±	0.8192	0.8995	±	0.0682
Si	103.9	±	6.153	8.591	±	0.5139
* P	0.0000	±	0.0508	0.0000	±	0.0042
* S	0.0000	±	0.0328	0.0000	±	0.0027
* Cl	0.0520	±	0.0407	0.0043	±	0.0034
K	4.170	±	0.3401	0.3449	±	0.0283
Ca	11.98	±	0.6125	0.9907	±	0.0513
Ti	0.4588	±	0.0282	0.0379	±	0.0024
* V	0.0056	±	0.0090	0.0005	±	0.0007
* Cr	0.0158	±	0.0079	0.0013	±	0.0007
Mn	0.0904	±	0.0136	0.0075	±	0.0011
Fe	4.390	±	0.2260	0.3631	±	0.0189
* Co	0.0000	±	0.0102	0.0000	±	0.0008
* Ni	0.0102	±	0.0068	0.0008	±	0.0006
* Cu	0.0102	±	0.0079	0.0008	±	0.0007
* Zn	0.0079	±	0.0068	0.0007	±	0.0006
* Ga	0.0011	±	0.0113	0.0001	±	0.0009
* Ge	0.0000	±	0.0124	0.0000	±	0.0010
* As	0.0000	±	0.0147	0.0000	±	0.0012
* Se	0.0034	±	0.0079	0.0003	±	0.0007
* Br	0.0079	±	0.0068	0.0007	±	0.0006
Rb	0.0316	±	0.0079	0.0026	±	0.0007
Sr	0.0441	±	0.0102	0.0036	±	0.0008
* Y	0.0000	±	0.0113	0.0000	±	0.0009
* Zr	0.0350	±	0.0136	0.0029	±	0.0011
* Mo	0.0000	±	0.0181	0.0000	±	0.0015
* Pd	0.0249	±	0.0452	0.0021	±	0.0037
* Ag	0.0000	±	0.0452	0.0000	±	0.0037
* Cd	0.0000	±	0.0463	0.0000	±	0.0038
* In	0.1006	±	0.0486	0.0083	±	0.0040
* Sn	0.0136	±	0.0565	0.0011	±	0.0047
* Sb	0.0667	±	0.0689	0.0055	±	0.0057
* Ba	0.0791	±	0.0497	0.0065	±	0.0041
* La	0.0000	±	0.0373	0.0000	±	0.0031
* Hf	0.0000	±	0.0429	0.0000	±	0.0036
* Hg	0.0328	±	0.0203	0.0027	±	0.0017
* Pb	0.0147	±	0.0215	0.0012	±	0.0018

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1838
Client ID: PS-OD-PM2.5-062712-02
Filter ID: P0458988
Sample Date: 6/27/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	801.	±	10.			
XRF						
Na	4.613	±	1.150	0.5759	±	0.1438
Mg	3.905	±	0.5266	0.4876	±	0.0660
Al	10.71	±	0.7786	1.338	±	0.0986
Si	66.75	±	3.880	8.333	±	0.4955
* P	0.0000	±	0.0396	0.0000	±	0.0049
* S	0.0531	±	0.0260	0.0066	±	0.0032
* Cl	0.0396	±	0.0407	0.0049	±	0.0051
K	4.321	±	0.2294	0.5395	±	0.0294
Ca	7.740	±	0.3978	0.9664	±	0.0511
Ti	0.5695	±	0.0328	0.0711	±	0.0042
* V	0.0170	±	0.0090	0.0021	±	0.0011
* Cr	0.0045	±	0.0079	0.0006	±	0.0010
Mn	0.1051	±	0.0136	0.0131	±	0.0017
Fe	5.117	±	0.2622	0.6388	±	0.0337
* Co	0.0023	±	0.0102	0.0003	±	0.0013
* Ni	0.0102	±	0.0068	0.0013	±	0.0008
* Cu	0.0000	±	0.0068	0.0000	±	0.0008
* Zn	0.0170	±	0.0068	0.0021	±	0.0008
* Ga	0.0226	±	0.0113	0.0028	±	0.0014
* Ge	0.0000	±	0.0124	0.0000	±	0.0016
* As	0.0249	±	0.0102	0.0031	±	0.0013
* Se	0.0124	±	0.0079	0.0016	±	0.0010
* Br	0.0147	±	0.0079	0.0018	±	0.0010
* Rb	0.0192	±	0.0079	0.0024	±	0.0010
Sr	0.0441	±	0.0102	0.0055	±	0.0013
* Y	0.0079	±	0.0113	0.0010	±	0.0014
Zr	0.0497	±	0.0136	0.0062	±	0.0017
* Mo	0.0000	±	0.0192	0.0000	±	0.0024
* Pd	0.0000	±	0.0452	0.0000	±	0.0056
* Ag	0.0000	±	0.0463	0.0000	±	0.0058
* Cd	0.0622	±	0.0463	0.0078	±	0.0058
* In	0.0000	±	0.0497	0.0000	±	0.0062
* Sn	0.0000	±	0.0554	0.0000	±	0.0069
* Sb	0.0678	±	0.0701	0.0085	±	0.0087
* Ba	0.0418	±	0.0508	0.0052	±	0.0063
* La	0.0000	±	0.0384	0.0000	±	0.0048
* Hf	0.0644	±	0.0429	0.0080	±	0.0054
Hg	0.0644	±	0.0203	0.0080	±	0.0025
* Pb	0.0000	±	0.0215	0.0000	±	0.0027

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1303
Client ID: PS-OD-PM2.5-061412
Filter ID: P0219200
Sample Date: 6/14/12 - 6/15/12
Filter Lot #: 45155
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	5,294.	±	10.			
XRF						
Na	22.44	±	5.305	0.4239	±	0.1002
Mg	13.57	±	1.933	0.2564	±	0.0365
Al	32.18	±	2.938	0.6079	±	0.0555
Si	191.8	±	13.58	3.622	±	0.2567
* P	0.0000	±	0.0881	0.0000	±	0.0017
* S	0.0599	±	0.0441	0.0011	±	0.0008
* Cl	0.0090	±	0.0475	0.0002	±	0.0009
K	10.97	±	0.5820	0.2072	±	0.0110
Ca	16.03	±	0.8339	0.3029	±	0.0158
Ti	1.209	±	0.0644	0.0228	±	0.0012
* V	0.0249	±	0.0113	0.0005	±	0.0002
* Cr	0.0090	±	0.0079	0.0002	±	0.0001
Mn	0.2384	±	0.0192	0.0045	±	0.0004
Fe	11.07	±	0.5594	0.2091	±	0.0106
* Co	0.0000	±	0.0124	0.0000	±	0.0002
* Ni	0.0000	±	0.0068	0.0000	±	0.0001
* Cu	0.0000	±	0.0068	0.0000	±	0.0001
Zn	0.0316	±	0.0068	0.0006	±	0.0001
* Ga	0.0000	±	0.0113	0.0000	±	0.0002
* Ge	0.0000	±	0.0102	0.0000	±	0.0002
* As	0.0000	±	0.0147	0.0000	±	0.0003
* Se	0.0158	±	0.0079	0.0003	±	0.0001
* Br	0.0192	±	0.0079	0.0004	±	0.0001
Rb	0.0396	±	0.0079	0.0007	±	0.0001
Sr	0.1153	±	0.0113	0.0022	±	0.0002
* Y	0.0090	±	0.0113	0.0002	±	0.0002
* Zr	0.0056	±	0.0136	0.0001	±	0.0003
* Mo	0.0170	±	0.0181	0.0003	±	0.0003
* Pd	0.0000	±	0.0463	0.0000	±	0.0009
* Ag	0.0000	±	0.0463	0.0000	±	0.0009
* Cd	0.0000	±	0.0463	0.0000	±	0.0009
* In	0.0000	±	0.0497	0.0000	±	0.0009
* Sn	0.0328	±	0.0565	0.0006	±	0.0011
* Sb	0.0836	±	0.0689	0.0016	±	0.0013
* Ba	0.1186	±	0.0701	0.0022	±	0.0013
* La	0.0034	±	0.0486	0.0001	±	0.0009
* Hf	0.0000	±	0.0418	0.0000	±	0.0008
* Hg	0.0011	±	0.0192	0.0000	±	0.0004
* Pb	0.0192	±	0.0215	0.0004	±	0.0004

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1802
Client ID: PS-OD-PM2.5-061512
Filter ID: P0458952
Sample Date: 6/15/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter		percent		
Gravimetry					
Net Mass	8,708.	± 10.			
XRF					
* Na	0.0000	± 17.09	0.0000	±	0.1962
* Mg	21.00	± 9.785	0.2411	±	0.1124
Al	206.3	± 24.72	2.370	±	0.2839
Si	1811.	±161.3	20.80	±	1.852
* P	0.0000	± 0.9481	0.0000	±	0.0109
* S	0.4464	± 0.2791	0.0051	±	0.0032
Cl	0.9334	± 0.2090	0.0107	±	0.0024
K	85.64	± 6.831	0.9835	±	0.0785
Ca	131.8	± 10.21	1.513	±	0.1172
Ti	9.550	± 0.4938	0.1097	±	0.0057
V	0.5594	± 0.0610	0.0064	±	0.0007
Cr	0.3424	± 0.0463	0.0039	±	0.0005
Mn	1.351	± 0.0746	0.0155	±	0.0009
Fe	81.81	± 4.096	0.9395	±	0.0471
* Co	0.0000	± 0.0350	0.0000	±	0.0004
Ni	0.0881	± 0.0181	0.0010	±	0.0002
Cu	0.3740	± 0.0429	0.0043	±	0.0005
Zn	0.1808	± 0.0147	0.0021	±	0.0002
* Ga	0.0203	± 0.0170	0.0002	±	0.0002
* Ge	0.0113	± 0.0147	0.0001	±	0.0002
* As	0.0000	± 0.0215	0.0000	±	0.0002
* Se	0.0079	± 0.0113	0.0001	±	0.0001
Br	0.0610	± 0.0113	0.0007	±	0.0001
Rb	0.3910	± 0.0237	0.0045	±	0.0003
Sr	1.219	± 0.0633	0.0140	±	0.0007
Y	0.1130	± 0.0158	0.0013	±	0.0002
Zr	0.6498	± 0.0384	0.0075	±	0.0004
* Mo	0.0000	± 0.0237	0.0000	±	0.0003
* Pd	0.0000	± 0.0667	0.0000	±	0.0008
* Ag	0.0203	± 0.0667	0.0002	±	0.0008
* Cd	0.0000	± 0.0678	0.0000	±	0.0008
* In	0.0452	± 0.0723	0.0005	±	0.0008
* Sn	0.0000	± 0.0791	0.0000	±	0.0009
* Sb	0.0655	± 0.1028	0.0008	±	0.0012
Ba	3.184	± 0.4418	0.0366	±	0.0051
* La	0.0000	± 0.3379	0.0000	±	0.0039
* Hf	0.0000	± 0.0644	0.0000	±	0.0007
* Hg	0.0463	± 0.0294	0.0005	±	0.0003
Pb	0.1684	± 0.0328	0.0019	±	0.0004

ICP	Conc.	MDL	Conc.	MDL
Al	101.6	0.750	1.166	0.0087
Ca	128.0	0.250	1.470	0.0033
Fe	75.05	0.100	0.8619	0.0015
Hf	< MDL	0.100	< MDL	0.0011
K	25.45	0.250	0.2923	0.0029
Mg	22.47	0.100	0.2580	0.0012
Mn	1.740	0.010	0.0200	0.0001
Na	7.605	0.600	0.0873	0.0069
Pb	0.251	0.250	0.0029	0.0029
Zr	0.145	0.050	0.0017	0.0006

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1813
Client ID: PS-OD-PM2.5-061812-02
Filter ID: P0458963
Sample Date: 6/18/12 - 6/19/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	1,714.	±	10.			
XRF						
* Na	1.081	±	1.090	0.0631	±	0.0636
Mg	4.230	±	1.037	0.2468	±	0.0605
Al	30.35	±	2.286	1.771	±	0.1338
Si	200.6	±	12.27	11.70	±	0.7192
* P	0.0000	±	0.0881	0.0000	±	0.0051
* S	0.1277	±	0.0768	0.0074	±	0.0045
Cl	0.5390	±	0.0655	0.0314	±	0.0038
K	11.08	±	0.5774	0.6464	±	0.0339
Ca	18.29	±	0.9368	1.067	±	0.0550
Ti	1.311	±	0.0701	0.0765	±	0.0041
* V	0.0237	±	0.0113	0.0014	±	0.0007
Cr	0.0305	±	0.0090	0.0018	±	0.0005
Mn	0.2102	±	0.0192	0.0123	±	0.0011
Fe	14.57	±	0.7345	0.8498	±	0.0431
* Co	0.0000	±	0.0147	0.0000	±	0.0009
* Ni	0.0000	±	0.0079	0.0000	±	0.0005
* Cu	0.0113	±	0.0079	0.0007	±	0.0005
Zn	0.0350	±	0.0079	0.0020	±	0.0005
* Ga	0.0260	±	0.0124	0.0015	±	0.0007
* Ge	0.0147	±	0.0113	0.0009	±	0.0007
* As	0.0000	±	0.0158	0.0000	±	0.0009
* Se	0.0203	±	0.0090	0.0012	±	0.0005
Br	0.1774	±	0.0136	0.0104	±	0.0008
Rb	0.0452	±	0.0090	0.0026	±	0.0005
Sr	0.1367	±	0.0124	0.0080	±	0.0007
* Y	0.0000	±	0.0124	0.0000	±	0.0007
Zr	0.0791	±	0.0158	0.0046	±	0.0009
* Mo	0.0000	±	0.0203	0.0000	±	0.0012
* Pd	0.1085	±	0.0497	0.0063	±	0.0029
* Ag	0.0181	±	0.0486	0.0011	±	0.0028
Cd	0.4204	±	0.0565	0.0245	±	0.0033
* In	0.0339	±	0.0531	0.0020	±	0.0031
* Sn	0.0000	±	0.0588	0.0000	±	0.0034
* Sb	0.0486	±	0.0757	0.0028	±	0.0044
* Ba	0.1785	±	0.0757	0.0104	±	0.0044
* La	0.0282	±	0.0531	0.0016	±	0.0031
* Hf	0.0373	±	0.0475	0.0022	±	0.0028
* Hg	0.0000	±	0.0260	0.0000	±	0.0015
* Pb	0.0056	±	0.0237	0.0003	±	0.0014

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1818
Client ID: PS-OD-PM2.5-062112-01
Filter ID: P0458968
Sample Date: 6/21/12
Filter Lot #: 77476
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Sx loss in slide

Analyte	µg/filter			percent		
Gravimetry						
Net Mass	916.	±	10.			
XRF						
Na	9.794	±	1.382	1.069	±	0.1513
Mg	5.108	±	0.5650	0.5576	±	0.0620
Al	11.36	±	0.8306	1.240	±	0.0917
Si	89.34	±	5.223	9.753	±	0.5800
* P	0.0000	±	0.0429	0.0000	±	0.0047
* S	0.0000	±	0.0305	0.0000	±	0.0033
Cl	0.1356	±	0.0441	0.0148	±	0.0048
K	4.382	±	0.2328	0.4784	±	0.0259
Ca	5.939	±	0.3074	0.6484	±	0.0343
Ti	0.4294	±	0.0271	0.0469	±	0.0030
* V	0.0215	±	0.0090	0.0023	±	0.0010
* Cr	0.0203	±	0.0079	0.0022	±	0.0009
Mn	0.0780	±	0.0124	0.0085	±	0.0014
Fe	5.297	±	0.2712	0.5783	±	0.0303
* Co	0.0000	±	0.0102	0.0000	±	0.0011
* Ni	0.0090	±	0.0068	0.0010	±	0.0007
* Cu	0.0045	±	0.0079	0.0005	±	0.0009
* Zn	0.0158	±	0.0068	0.0017	±	0.0007
* Ga	0.0136	±	0.0113	0.0015	±	0.0012
* Ge	0.0113	±	0.0102	0.0012	±	0.0011
* As	0.0000	±	0.0147	0.0000	±	0.0016
* Se	0.0113	±	0.0090	0.0012	±	0.0010
Br	0.0441	±	0.0079	0.0048	±	0.0009
Rb	0.0260	±	0.0079	0.0028	±	0.0009
Sr	0.0373	±	0.0102	0.0041	±	0.0011
* Y	0.0023	±	0.0113	0.0002	±	0.0012
Zr	0.0441	±	0.0136	0.0048	±	0.0015
* Mo	0.0113	±	0.0192	0.0012	±	0.0021
* Pd	0.0000	±	0.0463	0.0000	±	0.0051
* Ag	0.0000	±	0.0463	0.0000	±	0.0051
* Cd	0.1119	±	0.0486	0.0122	±	0.0053
* In	0.0000	±	0.0497	0.0000	±	0.0054
* Sn	0.0000	±	0.0554	0.0000	±	0.0060
* Sb	0.0136	±	0.0701	0.0015	±	0.0076
* Ba	0.0045	±	0.0497	0.0005	±	0.0054
* La	0.0000	±	0.0384	0.0000	±	0.0042
* Hf	0.0000	±	0.0441	0.0000	±	0.0048
* Hg	0.0000	±	0.0249	0.0000	±	0.0027
* Pb	0.0294	±	0.0215	0.0032	±	0.0023

* - XRF Concentration is less than three times the uncertainty

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-X1221
Client ID: PS-OD-PM2.5 Imp-061312
Sample Date: 6/13/12 - 6/14/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	3.60	0.750
Ca	46.2	0.250
Fe	3.08	0.100
Hf	< MDL	0.100
K	1.36	0.250
Mg	1.09	0.100
Mn	0.105	0.010
Na	3.83	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1222
Client ID: PS-OD-PM2.5 Imp-062712-02
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	3.68	0.750
Ca	52.6	0.250
Fe	2.98	0.100
Hf	< MDL	0.100
K	1.43	0.250
Mg	1.06	0.100
Mn	0.121	0.010
Na	4.50	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1223
Client ID: PS-OD-PM2.5 Imp-061412
Sample Date: 6/14/12 - 6/15/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	13.4	0.750
Ca	145.	0.250
Fe	11.1	0.100
Hf	< MDL	0.100
K	3.66	0.250
Mg	3.72	0.100
Mn	0.339	0.010
Na	3.97	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-X1224
Client ID: PS-OD-PM2.5 Imp-061512
Sample Date: 6/15/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	127.	0.750
Ca	206.	0.250
Fe	171.	0.100
Hf	< MDL	0.100
K	30.9	0.250
Mg	38.8	0.100
Mn	2.90	0.010
Na	6.84	0.600
Pb	< MDL	0.250
Zr	0.213	0.050

Lab ID: 12-X1225
Client ID: PS-OD-PM2.5 Imp-061812-02
Sample Date: 6/18/12 - 6/19/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	11.5	0.750
Ca	45.9	0.250
Fe	10.8	0.100
Hf	< MDL	0.100
K	2.91	0.250
Mg	2.47	0.100
Mn	0.224	0.010
Na	4.56	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Lab ID: 12-X1226
Client ID: PS-OD-PM2.5 Imp-062112-01
Sample Date: 6/21/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5

Analyte	µg/filter Conc.	MDL
ICP		
Al	6.17	0.750
Ca	53.9	0.250
Fe	5.45	0.100
Hf	< MDL	0.100
K	1.89	0.250
Mg	1.41	0.100
Mn	0.144	0.010
Na	3.29	0.600
Pb	< MDL	0.250
Zr	< MDL	0.050

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-T1846
Client ID: PS-OB-PM2.5-062712-01-OR
Sample Date: 6/27/12
Deposit Area: 11.3 cm²
Size Fraction: PM2.5
Comments: Burn

Analyte	µg/filter Conc.	MDL
Gravimetry		
Net Mass	3,670.	
ICP		
Al	188.	0.750

Lab ID: 12-T1848
Client ID: PS-OB-PM10-062712-01-OR
Sample Date: 6/27/12
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Burn # 6-9

Analyte	µg/filter Conc.	MDL
Gravimetry		
Net Mass	3,703.	
ICP		
Al	179.	0.750

Lab ID: 12-T1849
Client ID: PS-OB-PM10-062712-02-OR
Sample Date: 6/27/12
Deposit Area: 11.3 cm²
Size Fraction: PM10
Comments: Burn # 1-4

Analyte	µg/filter Conc.	MDL
Gravimetry		
Net Mass	2,215.	
ICP		
Al	130.	0.750
Fe	5.32	0.100

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-X1227
Client ID: PS-OB-PM10 Imp-062712-01-OR
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: PM10
Comments: Burn # 6-9

Analyte	µg/filter Conc.	MDL
ICP		
Al	2.23	0.750

Lab ID: 12-X1228
Client ID: PS-OB-PM10 Imp-062712-02-OR
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: PM10
Comments: Burn # 1-4

Analyte	µg/filter Conc.	MDL
ICP		
Al	1.48	0.750
Fe	13.4	0.100

Lab ID: 12-X1229
Client ID: PS-OB-PM2.5 Imp-062712-01-OR
Sample Date: 6/27/12
Deposit Area: 9.62 cm²
Size Fraction: PM2.5
Comments: Burn # 1-5

Analyte	µg/filter Conc.	MDL
ICP		
Al	1.27	0.750

Analysis performed by: ***CHESTER LabNet***
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Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-S8
Client ID: BS-Soil-061112
Sample Date: 6/11/12

Analyte	Result	MDL	Units
Aluminum, ICP	3,940	1.48	µg/g
Calcium, ICP	7,670	0.494	µg/g
Hafnium, ICP	< MDL	0.198	µg/g
Iron, ICP	5,060	0.198	µg/g
Lead, ICP	1.06	0.494	µg/g
Magnesium, ICP	1,710	0.198	µg/g
Manganese, ICP	101.	0.020	µg/g
Potassium, ICP	1,140	0.494	µg/g
Sodium, ICP	90.4	1.19	µg/g
Zirconium, ICP	3.94	0.099	µg/g

Lab ID: 12-S9
Client ID: BS-Soil-CompB-061812
Sample Date: 6/18/12

Analyte	Result	MDL	Units
Aluminum, ICP	3,450	1.45	µg/g
Calcium, ICP	7,820	0.483	µg/g
Hafnium, ICP	< MDL	0.193	µg/g
Iron, ICP	5,040	0.193	µg/g
Lead, ICP	1.35	0.483	µg/g
Magnesium, ICP	1,680	0.193	µg/g
Manganese, ICP	90.6	0.019	µg/g
Potassium, ICP	1,110	0.483	µg/g
Sodium, ICP	128.	1.16	µg/g
Zirconium, ICP	4.56	0.097	µg/g

Lab ID: 12-S10
Client ID: BS-Soil-061912
Sample Date: 6/19/12

Analyte	Result	MDL	Units
Aluminum, ICP	3,470	1.40	µg/g
Calcium, ICP	5,870	0.466	µg/g
Hafnium, ICP	< MDL	0.187	µg/g
Iron, ICP	4,980	0.187	µg/g
Lead, ICP	1.16	0.466	µg/g
Magnesium, ICP	1,220	0.187	µg/g
Manganese, ICP	83.9	0.019	µg/g
Potassium, ICP	922.	0.466	µg/g
Sodium, ICP	73.6	1.12	µg/g
Zirconium, ICP	3.79	0.093	µg/g

Client: A053 - Arcadis
Report Number: 12-376

Lab ID: 12-S11
Client ID: BS-Soil-V453-062212
Sample Date: 6/22/12

Analyte	Result	MDL	Units
Aluminum, ICP	3,810	1.41	µg/g
Calcium, ICP	6,370	0.469	µg/g
Hafnium, ICP	< MDL	0.188	µg/g
Iron, ICP	4,860	0.188	µg/g
Lead, ICP	1.35	0.469	µg/g
Magnesium, ICP	1,400	0.188	µg/g
Manganese, ICP	90.5	0.019	µg/g
Potassium, ICP	1,120	0.469	µg/g
Sodium, ICP	104.	1.13	µg/g
Zirconium, ICP	8.49	0.094	µg/g

Lab ID: 12-S12
Client ID: BS-Soil-V548-062812
Sample Date: 6/28/12

Analyte	Result	MDL	Units
Aluminum, ICP	4,220	1.34	µg/g
Calcium, ICP	5,560	0.447	µg/g
Hafnium, ICP	< MDL	0.179	µg/g
Iron, ICP	5,070	0.179	µg/g
Lead, ICP	0.75	0.447	µg/g
Magnesium, ICP	1,550	0.179	µg/g
Manganese, ICP	103.	0.018	µg/g
Potassium, ICP	1,230	0.447	µg/g
Sodium, ICP	100.	1.07	µg/g
Zirconium, ICP	3.18	0.089	µg/g

Analysis performed by: ***CHESTER LabNet***
12242 SW Garden Place ♦ Tigard, OR 97223 ♦ (503) 624-2183 ♦ www.chesterlab.net

QA/QC

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

CHESTER LabNet

XRF-770 **XRF Analytical Quality Assurance Report**

Client: Arcadis
Report: 12-376
Analysis Period: August 30 , 2012
Number of Samples: 12

1. Precision Data

Micromatter Multi-elemental Quality Control Standard: QS285

QC Standard Results

Analyte	n	Counts per Second			c.v.	%E
		Calib.	Meas.	S.D.		
Si(0)	1	505.28	514.40	na	na	1.80
Ti(1)	1	352.43	371.97	na	na	5.54
Fe(1)	1	789.82	828.30	na	na	4.87
Se(3)	1	256.46	265.70	na	na	3.60
Pb(3)	1	285.75	296.50	na	na	3.76
Cd(4)	1	199.30	200.02	na	na	0.36

2. Accuracy Data

NIST Standard Reference Materials: SRM 1832, SRM 1833, SRM 2783

Analyte/ SRM	n	Certified Value(µg/cm²)	Measured Value (µg/cm²)			% Rec.
			High	Low	Average	
Al 1832	4	14.6 +/- .97	15.26	14.85	15.06 +/- 0.19	103.2
Si 1832	4	34.0 +/- 1.1	34.84	33.22	34.05 +/- 0.57	100.1
Si 1833	4	31.5 +/- 2.1	31.05	30.61	30.80 +/- 0.19	97.8
S 2708	4	2.46 +/- .25	2.46	2.32	2.39 +/- 0.05	97.0
K 1833	4	16.4 +/- 1.64	16.87	16.53	16.67 +/- 0.14	101.7
Ca 2783	4	1.33 +/- 0.17	1.29	1.28	1.28 +/- 0.01	96.6
Ti 1833	4	12.1 +/- 1.79	11.65	11.31	11.48 +/- 0.12	94.9
V 1832	4	4.70 +/- .49	4.65	4.57	4.61 +/- 0.03	98.1
Mn 1832	4	4.54 +/- .49	4.54	4.48	4.51 +/- 0.02	99.4
Fe 1833	4	13.6 +/- .45	13.28	13.12	13.22 +/- 0.06	97.2
Cu 1832	4	2.43 +/- .16	2.52	2.44	2.48 +/- 0.03	101.9
Zn 2783	4	.188 +/- .013	0.187	0.181	0.185 +/- 0.00	102.9
Pb 1833	4	16.1 +/- .75	16.36	15.89	16.08 +/- 0.18	99.9

NIST: National Institute of Standards and Technology
% Rec: Percent Recovery = (Experimental/Given) x 100
n: Number of Observations
S.D.: Standard Deviation
c.v.: Coefficient of Variation = (S.D./Measured) x 100
% E: Percent Error = [(Measured-Calibrated)/Calibrated] x 100

XRF-770 REPLICATE REPORT

3.68

Original ID: 12-T1802

Replicate ID: RT1802

Filter Lot:

Deposit Mass: 8708 µg

Deposit Area: 11.3 cm²

Particle Size: F

Element	Original ug/cm2			Replicate ug/cm2			Difference ug/cm2			RPD		
Na	0.0000	+-	1.5125	0.0000	+-	1.5616	0.0000	+-	2.1740			
Mg	1.8583	+-	0.8659	1.6857	+-	0.8685	0.1726	+-	1.2264			
Al	18.2610	+-	2.1880	18.1685	+-	2.1764	0.0925	+-	3.0861	+	0.5	+- 16.9
Si	160.2916	+-	14.2740	160.2331	+-	14.2643	0.0585	+-	20.1796	+	0.0	+- 12.6
P	0.0000	+-	0.0839	0.0000	+-	0.0903	0.0000	+-	0.1233			
S	0.0395	+-	0.0247	0.0680	+-	0.0248	-0.0285	+-	0.0350			
Cl	0.0826	+-	0.0185	0.0396	+-	0.0177	0.0430	+-	0.0256	0	70.4	+- 41.9
K	7.5794	+-	0.6045	7.5909	+-	0.6051	-0.0115	+-	0.8553	+	-0.2	+- 11.3
Ca	11.6616	+-	0.9033	11.6553	+-	0.9025	0.0063	+-	1.2769	+	0.1	+- 11.0
Ti	0.8451	+-	0.0437	0.8555	+-	0.0441	-0.0105	+-	0.0621	+	-1.2	+- 7.3
V	0.0495	+-	0.0054	0.0500	+-	0.0054	-0.0006	+-	0.0076	+	-1.1	+- 15.3
Cr	0.0303	+-	0.0041	0.0304	+-	0.0042	-0.0002	+-	0.0059	+	-0.6	+- 19.3
Mn	0.1196	+-	0.0066	0.1212	+-	0.0067	-0.0016	+-	0.0094	+	-1.4	+- 7.8
Fe	7.2400	+-	0.3625	7.2606	+-	0.3636	-0.0207	+-	0.5134	+	-0.3	+- 7.1
Co	0.0000	+-	0.0031	0.0000	+-	0.0031	0.0000	+-	0.0044			
Ni	0.0078	+-	0.0016	0.0042	+-	0.0016	0.0037	+-	0.0023	0	61.2	+- 38.3
Cu	0.0331	+-	0.0038	0.0350	+-	0.0024	-0.0019	+-	0.0045	+	-5.5	+- 13.2
Zn	0.0160	+-	0.0013	0.0140	+-	0.0012	0.0021	+-	0.0018	0	13.7	+- 12.0
Ga	0.0018	+-	0.0015	0.0058	+-	0.0015	-0.0040	+-	0.0021			
Ge	0.0010	+-	0.0013	0.0048	+-	0.0014	-0.0038	+-	0.0019			
As	0.0000	+-	0.0019	0.0013	+-	0.0019	-0.0013	+-	0.0027			
Se	0.0007	+-	0.0010	0.0016	+-	0.0010	-0.0009	+-	0.0014			
Br	0.0054	+-	0.0010	0.0045	+-	0.0010	0.0010	+-	0.0014	+	19.9	+- 28.0
Rb	0.0346	+-	0.0021	0.0359	+-	0.0022	-0.0013	+-	0.0030	+	-3.6	+- 8.5
Sr	0.1079	+-	0.0056	0.1051	+-	0.0055	0.0028	+-	0.0079	+	2.6	+- 7.4
Y	0.0100	+-	0.0014	0.0108	+-	0.0015	-0.0008	+-	0.0020	+	-7.6	+- 19.7
Zr	0.0575	+-	0.0034	0.0590	+-	0.0034	-0.0015	+-	0.0048	+	-2.6	+- 8.3
Mo	0.0000	+-	0.0021	0.0000	+-	0.0021	0.0000	+-	0.0030			
Pd	0.0000	+-	0.0059	0.0000	+-	0.0058	0.0000	+-	0.0083			
Ag	0.0018	+-	0.0059	0.0084	+-	0.0059	-0.0066	+-	0.0084			
Cd	0.0000	+-	0.0060	0.0031	+-	0.0060	-0.0031	+-	0.0084			
In	0.0040	+-	0.0064	0.0000	+-	0.0064	0.0040	+-	0.0091			
Sn	0.0000	+-	0.0070	0.0000	+-	0.0070	0.0000	+-	0.0099			
Sb	0.0058	+-	0.0091	0.0171	+-	0.0092	-0.0114	+-	0.0130			
Ba	0.2818	+-	0.0391	0.2589	+-	0.0389	0.0229	+-	0.0552	+	8.5	+- 20.4
La	0.0000	+-	0.0299	0.0000	+-	0.0299	0.0000	+-	0.0423			
Hf	0.0000	+-	0.0057	0.0000	+-	0.0056	0.0000	+-	0.0080			
Hg	0.0041	+-	0.0026	0.0000	+-	0.0030	0.0041	+-	0.0040			
Pb	0.0149	+-	0.0029	0.0077	+-	0.0028	0.0073	+-	0.0040	0	64.4	+- 35.4

RPD: Relative Percent Difference (X1-X2)/[(X1+X2)/2]*100. RPD is calculated when original value is greater than three times its uncertainty.

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
Al	ICB	< MDL	15.0
Al	PrepBlkT	22.0	15.0
Al	*MethBlkT**	*2.61*	*0.750*
Al	CCB	< MDL	15.0
Al	PrepBlkP	< MDL	15.0
Al	MethBlkP	16.6	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	ICB	< MDL	15.0
Al	CCB	< MDL	15.0
Ca	ICB	< MDL	5.00
Ca	PrepBlkT	40.4	5.00
Ca	*MethBlkT**	*1.73*	*0.250*
Ca	CCB	< MDL	5.00
Ca	PrepBlkP	7.41	5.00
Ca	MethBlkP	1860	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	ICB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Fe	ICB	< MDL	2.00
Fe	PrepBlkT	< MDL	2.00
Fe	*MethBlkT**	*0.117*	*0.100*
Fe	CCB	< MDL	2.00
Fe	PrepBlkP	< MDL	2.00
Fe	MethBlkP	5.70	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	ICB	< MDL	2.00
Fe	CCB	< MDL	2.00
Hf	ICB	< MDL	2.00
Hf	PrepBlkT	< MDL	2.00
Hf	*MethBlkT**	*< MDL*	*0.100*
Hf	CCB	< MDL	2.00
Hf	PrepBlkP	< MDL	2.00
Hf	MethBlkP	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
K	ICB	< MDL	5.00
K	PrepBlkT	< MDL	5.00
K	*MethBlkT**	*0.327*	*0.250*

*: Method Blank concentration in µg/filter

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
K	CCB	< MDL	5.00
K	PrepBlkP	< MDL	5.00
K	MethBlkP	11.2	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
Mg	ICB	< MDL	2.00
Mg	PrepBlkT	6.68	2.00
Mg	*MethBlkT**	*0.162*	*0.100*
Mg	CCB	< MDL	2.00
Mg	PrepBlkP	< MDL	2.00
Mg	MethBlkP	4.57	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	ICB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mn	ICB	< MDL	0.200
Mn	PrepBlkT	0.519	0.200
Mn	*MethBlkT**	*0.030*	*0.010*
Mn	CCB	< MDL	0.200
Mn	PrepBlkP	0.474	0.200
Mn	MethBlkP	1.44	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Na	ICB	< MDL	12.0
Na	PrepBlkT	30.9	12.0
Na	*MethBlkT**	*2.41*	*0.600*
Na	CCB	< MDL	12.0
Na	PrepBlkP	23.3	12.0
Na	MethBlkP	66.9	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Pb	ICB	< MDL	5.00
Pb	PrepBlkT	< MDL	5.00
Pb	*MethBlkT**	*0.250*	*0.250*
Pb	CCB	< MDL	5.00
Pb	PrepBlkP	< MDL	5.00
Pb	MethBlkP	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00

*: Method Blank concentration in µg/filter

QA/QC Limits
Continuing Calibration: ± 10%
Duplicates: 20% RPD
LCS: ± 20%
Spikes: ± 25%

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
Zr	ICB	< MDL	1.00
Zr	PrepBlkT	< MDL	1.00
Zr	*MethBlkT**	*< MDL*	*0.050*
Zr	CCB	< MDL	1.00
Zr	PrepBlkP	< MDL	1.00
Zr	MethBlkP	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00

*: Method Blank concentration in µg/filter

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Al	ICV	2500	2510	100.5
Al	*CRI*	*75.0*	*76.5*	*101.9*
Al	CCV	2500	2440	97.4
Al	CCV	2500	2470	98.9
Al	CCV	2500	2440	97.7
Al	CCV	2500	2460	98.2
Al	ICV	2500	2430	97.2
Al	*CRI*	*75.0*	*62.7*	*83.6*
Al	CCV	2500	2410	96.5
Ca	ICV	1000	995.	99.5
Ca	*CRI*	*25.0*	*28.8*	*115.0*
Ca	CCV	1000	982.	98.2
Ca	CCV	1000	979.	97.9
Ca	CCV	1000	970.	97.0
Ca	CCV	1000	989.	98.9
Ca	CCV	1000	991.	99.1
Ca	ICV	1000	959.	95.9
Ca	*CRI*	*25.0*	*28.1*	*112.6*
Ca	CCV	1000	954.	95.4
Ca	CCV	1000	950.	95.0
Ca	CCV	1000	947.	94.7
Fe	ICV	1000	990.	99.0
Fe	*CRI*	*10.0*	*13.0*	*129.6*
Fe	CCV	1000	967.	96.7
Fe	CCV	1000	953.	95.3
Fe	CCV	1000	943.	94.3
Fe	CCV	1000	955.	95.5
Fe	CCV	1000	976.	97.6
Fe	ICV	1000	975.	97.5
Fe	*CRI*	*10.0*	*12.8*	*127.6*
Fe	CCV	1000	960.	96.0

CRI Limits: 20% - 200% Recovery

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Hf	ICV	1000	982.	98.2
Hf	*CRI*	*10.0*	*9.32*	*93.2*
Hf	CCV	1000	984.	98.4
Hf	CCV	1000	979.	97.9
Hf	CCV	1000	971.	97.1
Hf	CCV	1000	981.	98.1
Hf	CCV	1000	990.	99.0
K	ICV	2500	2270	90.9
K	*CRI*	*25.0*	*19.0*	*75.9*
K	CCV	2500	2290	91.6
K	CCV	2500	2270	90.7
K	CCV	2500	2280	91.2
K	CCV	2500	2270	90.7
K	CCV	2500	2290	91.7
Mg	ICV	1000	986.	98.6
Mg	*CRI*	*10.0*	*9.95*	*99.5*
Mg	CCV	1000	978.	97.8
Mg	CCV	1000	978.	97.8
Mg	CCV	1000	957.	95.7
Mg	CCV	1000	984.	98.4
Mg	CCV	1000	975.	97.5
Mg	ICV	1000	982.	98.2
Mg	*CRI*	*10.0*	*9.75*	*97.5*
Mg	CCV	1000	983.	98.3
Mn	ICV	1000	988.	98.8
Mn	*CRI*	*1.00*	*1.20*	*119.5*
Mn	CCV	1000	971.	97.1
Mn	CCV	1000	947.	94.7
Mn	CCV	1000	950.	95.0
Mn	CCV	1000	959.	95.9
Mn	CCV	1000	972.	97.2
Na	ICV	2500	2300	91.8
Na	*CRI*	*60.0*	*44.5*	*74.2*
Na	CCV	2500	2310	92.4
Na	CCV	2500	2300	92.0
Na	CCV	2500	2290	91.4
Na	CCV	2500	2330	93.2
Na	CCV	2500	2290	91.8
Pb	ICV	1000	998.	99.8
Pb	*CRI*	*25.0*	*24.9*	*99.7*
Pb	CCV	1000	992.	99.2
Pb	CCV	1000	988.	98.8
Pb	CCV	1000	972.	97.2
Pb	CCV	1000	978.	97.8
Pb	CCV	1000	995.	99.5
Zr	ICV	1000	925.	92.5
Zr	*CRI*	*5.00*	*4.35*	*87.1*
Zr	CCV	1000	956.	95.6
Zr	CCV	1000	962.	96.2
Zr	CCV	1000	973.	97.3
Zr	CCV	1000	944.	94.4
Zr	CCV	1000	936.	93.6

CRI Limits: 20% - 200% Recovery

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Replicate Data

Analyte	Sample ID	Sample Conc. µg/L	Replicate Conc. µg/L	RPD
Al	12-T1802	2031.	2122.	4.38
Al	12-X1215	49.55	47.96	3.26 #
Ca	12-T1802	2561.	2533.	1.10
Ca	12-X1215	2218.	2199.	0.86
Fe	12-T1802	1501.	1511.	0.66
Fe	12-X1215	37.25	37.85	1.60
Hf	12-T1802	< 2	< 2	N/C #
Hf	12-X1215	< 2	< 2	N/C #
K	12-T1802	509.0	512.1	0.61
K	12-X1215	25.87	25.68	0.74
Mg	12-T1802	449.4	448.3	0.25
Mg	12-X1215	17.22	17.68	2.64
Mn	12-T1802	34.81	35.16	1.00
Mn	12-X1215	2.488	2.541	2.11
Na	12-T1802	152.1	153.1	0.66
Na	12-X1215	84.96	84.12	0.99
Pb	12-T1802	5.015	< 5	N/C #
Pb	12-X1215	< 5	< 5	N/C #
Zr	12-T1802	2.904	2.338	21.6 #
Zr	12-X1215	< 1	< 1	N/C #

RPD = {(sample-replicate)/[(sample+replicate)/2]}x100
N/C: RPD is not calculated when sample or replicate is below detection limit
#: per EPA CLP protocol, control limits do not apply if sample and/or replicate concentration is less than 5x the detection limit

Laboratory Control Sample/Matrix Post Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Al	LCS-TFE	52.20	1280.	1000.	123.
Al	12-T1805	217.8	1181.	1000.	96.3
Al	LCS-Poly	16.60	1164.	1000.	115.
Al	12-X1216	63.17	1022.	1000.	95.9
Ca	LCS-TFE	34.57	1026.	1000.	99.1
Ca	12-T1805	302.2	1217.	1000.	91.5
Ca	LCS-Poly	1861.	2576.	1000.	71.5
Ca	12-X1216	2564.	7180.	5000.	92.3
Fe	LCS-TFE	2.348	1009.	1000.	101.
Fe	12-T1805	108.4	1054.	1000.	94.6
Fe	LCS-Poly	5.700	988.5	1000.	98.3

*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **47mm TFE, 47mm Polycarbonate**
Report Number: 12-376

Laboratory Control Sample/Matrix Post Spike Analysis

Analyte	Sample ID	Sample Conc. µg/L	Spike Conc. µg/L	Spike Amount µg/L	Percent Recovery
Fe	12-X1216	45.40	1016.	1000.	97.1
Hf	LCS-TFE	< 2	1017.	1000.	102.
Hf	12-T1805	< 2	958.0	1000.	95.8
Hf	LCS-Poly	< 2	1000.	1000.	100.
Hf	12-X1216	< 2	985.0	1000.	98.5
K	LCS-TFE	6.542	955.1	1000.	94.9
K	12-T1805	45.63	846.4	1000.	80.1
K	LCS-Poly	11.18	940.6	1000.	92.9
K	12-X1216	34.53	864.0	1000.	82.9
Mg	LCS-TFE	3.244	992.1	1000.	98.9
Mg	12-T1805	43.99	994.9	1000.	95.1
Mg	LCS-Poly	4.574	985.8	1000.	98.1
Mg	12-X1216	19.72	996.6	1000.	97.7
Mn	LCS-TFE	0.591	990.7	1000.	99.0
Mn	12-T1805	2.978	949.3	1000.	94.6
Mn	LCS-Poly	1.445	989.0	1000.	98.8
Mn	12-X1216	2.693	983.5	1000.	98.1
Na	LCS-TFE	48.22	1334.	1000.	129.
Na	12-T1805	52.66	927.4	1000.	87.5
Na	LCS-Poly	66.87	1214.	1000.	115.
Na	12-X1216	94.19	955.6	1000.	86.1
Pb	LCS-TFE	5.005	1002.	1000.	99.7
Pb	12-T1805	< 5	943.9	1000.	94.4
Pb	LCS-Poly	< 5	992.5	1000.	99.2
Pb	12-X1216	< 5	1007.	1000.	101.
Zr	LCS-TFE	< 1	916.6	1000.	91.7
Zr	LCS-Poly	< 1	914.2	1000.	91.4
Zr	12-X1216	< 1	909.9	1000.	91.0
Zr	12-T1805	< 1	920.4	1000.	92.0

Percent Recovery = (spike - sample)/spike amount*100
*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **Soil**
Report Number: 12-376

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
Al	ICB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	CCB	< MDL	15.0
Al	PrepBlkS	< MDL	15.0
Al	CCB	< MDL	15.0
Al	ICB	< MDL	15.0
Al	CCB	< MDL	15.0
Ca	ICB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	PrepBlkS	16.6	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	ICB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Ca	CCB	< MDL	5.00
Fe	ICB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	PrepBlkS	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	CCB	< MDL	2.00
Fe	ICB	< MDL	2.00
Fe	CCB	< MDL	2.00
Hf	ICB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	PrepBlkS	< MDL	2.00
Hf	CCB	< MDL	2.00
Hf	CCB	< MDL	2.00
K	ICB	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
K	PrepBlkS	< MDL	5.00
K	CCB	< MDL	5.00
K	CCB	< MDL	5.00
Mg	ICB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	PrepBlkS	2.64	2.00
Mg	CCB	< MDL	2.00
Mg	CCB	< MDL	2.00
Mg	ICB	< MDL	2.00
Mg	CCB	< MDL	2.00

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **Soil**
Report Number: 12-376

Blank Data

Analyte	Sample ID	Measured Conc. µg/L	MDL Conc. µg/L
Mn	ICB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Mn	PrepBlkS	0.627	0.200
Mn	CCB	< MDL	0.200
Mn	CCB	< MDL	0.200
Na	ICB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Na	PrepBlkS	20.6	12.0
Na	CCB	< MDL	12.0
Na	CCB	< MDL	12.0
Pb	ICB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	PrepBlkS	< MDL	5.00
Pb	CCB	< MDL	5.00
Pb	CCB	< MDL	5.00
Zr	ICB	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	PrepBlkP	< MDL	1.00
Zr	MethBlkP	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	PrepBlkS	< MDL	1.00
Zr	CCB	< MDL	1.00
Zr	CCB	< MDL	1.00

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **Soil**
Report Number: 12-376

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Al	ICV	2500	2510	100.5
Al	CRI	75.0	76.5	101.9
Al	CCV	2500	2440	97.4
Al	CCV	2500	2470	98.9
Al	CCV	2500	2440	97.7
Al	CCV	2500	2460	98.2
Al	ICV	2500	2430	97.2
Al	CRI	75.0	62.7	83.6
Al	CCV	2500	2410	96.5
Ca	ICV	1000	995.	99.5
Ca	CRI	25.0	28.8	115.0
Ca	CCV	1000	982.	98.2
Ca	CCV	1000	979.	97.9
Ca	CCV	1000	970.	97.0
Ca	CCV	1000	989.	98.9
Ca	CCV	1000	991.	99.1
Ca	ICV	1000	959.	95.9
Ca	CRI	25.0	28.1	112.6
Ca	CCV	1000	954.	95.4
Ca	CCV	1000	950.	95.0
Ca	CCV	1000	947.	94.7
Fe	ICV	1000	990.	99.0
Fe	CRI	10.0	13.0	129.6
Fe	CCV	1000	967.	96.7
Fe	CCV	1000	953.	95.3
Fe	CCV	1000	943.	94.3
Fe	CCV	1000	955.	95.5
Fe	CCV	1000	976.	97.6
Fe	ICV	1000	975.	97.5
Fe	CRI	10.0	12.8	127.6
Fe	CCV	1000	960.	96.0
Hf	ICV	1000	982.	98.2
Hf	CRI	10.0	9.32	93.2
Hf	CCV	1000	984.	98.4
Hf	CCV	1000	979.	97.9
Hf	CCV	1000	971.	97.1
Hf	CCV	1000	981.	98.1
Hf	CCV	1000	990.	99.0
K	ICV	2500	2270	90.9
K	CRI	25.0	19.0	75.9
K	CCV	2500	2290	91.6
K	CCV	2500	2270	90.7
K	CCV	2500	2280	91.2
K	CCV	2500	2270	90.7
K	CCV	2500	2290	91.7

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **Soil**
Report Number: 12-376

Calibration QC

Analyte	Sample ID	Standard Conc. µg/L	Measured Conc. µg/L	Percent Recovery
Mg	ICV	1000	986.	98.6
Mg	CRI	10.0	9.95	99.5
Mg	CCV	1000	978.	97.8
Mg	CCV	1000	978.	97.8
Mg	CCV	1000	957.	95.7
Mg	CCV	1000	984.	98.4
Mg	CCV	1000	975.	97.5
Mg	ICV	1000	982.	98.2
Mg	CRI	10.0	9.75	97.5
Mg	CCV	1000	983.	98.3
Mn	ICV	1000	988.	98.8
Mn	CRI	1.00	1.20	119.5
Mn	CCV	1000	971.	97.1
Mn	CCV	1000	947.	94.7
Mn	CCV	1000	950.	95.0
Mn	CCV	1000	959.	95.9
Mn	CCV	1000	972.	97.2
Na	ICV	2500	2300	91.8
Na	CRI	60.0	44.5	74.2
Na	CCV	2500	2310	92.4
Na	CCV	2500	2300	92.0
Na	CCV	2500	2290	91.4
Na	CCV	2500	2330	93.2
Na	CCV	2500	2290	91.8
Pb	ICV	1000	998.	99.8
Pb	CRI	25.0	24.9	99.7
Pb	CCV	1000	992.	99.2
Pb	CCV	1000	988.	98.8
Pb	CCV	1000	972.	97.2
Pb	CCV	1000	978.	97.8
Pb	CCV	1000	995.	99.5
Zr	ICV	1000	925.	92.5
Zr	CRI	5.00	4.35	87.1
Zr	CCV	1000	956.	95.6
Zr	CCV	1000	962.	96.2
Zr	CCV	1000	973.	97.3
Zr	CCV	1000	944.	94.4
Zr	CCV	1000	936.	93.6

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

QA/QC Report

Client Name: Arcadis
Project Number: A053
Analytical Technique: ICP - Optima 2000
Sample Description: **Soil**
Report Number: 12-376

Duplicate Data

Analyte	Sample ID	Sample Conc. µg/g	Duplicate Conc. µg/g	RPD
Al	12-S8	3940	4050	2.84
Ca	12-S8	7670	8210	6.82
Fe	12-S8	5060	5220	3.19
Hf	12-S8	< 0.198	< 0.199	N/C #
K	12-S8	1140	1170	2.34
Mg	12-S8	1710	1730	1.09
Mn	12-S8	101.	101.	0.28
Na	12-S8	90.4	97.9	7.91
Pb	12-S8	1.06	1.31	21.1 #
Zr	12-S8	3.94	3.00	27.2

RPD = {(sample-duplicate)/[(sample+duplicate)/2]}x100
N/C: RPD is not calculated when sample or duplicate is below detection limit
#: per EPA CLP protocol, control limits do not apply if sample and/or duplicate concentration is less than 5x the detection limit

Laboratory Control Sample/Matrix Spike Analysis

Analyte	Sample ID	Sample Conc. µg/g	Spike Conc. µg/g	Spike Amount µg/g	Percent Recovery
Al	LCS-Soil	< 1.48	114.	98.2	116.
Al	12-S8	3940	5480	98.2	1570 *
Ca	LCS-Soil	1.63	96.5	98.2	96.6
Ca	12-S8	7670	8240	98.2	587. *
Fe	LCS-Soil	< 0.198	95.5	98.2	97.2
Fe	12-S8	5060	5380	98.2	332. *
Hf	LCS-Soil	< 0.198	101.	98.2	103.
Hf	12-S8	< 0.198	84.4	98.2	86.0
K	LCS-Soil	< 0.494	98.0	98.2	99.8
K	12-S8	1140	1530	98.2	389. *
Mg	LCS-Soil	0.261	96.7	98.2	98.2
Mg	12-S8	1710	1920	98.2	216. *
Mn	LCS-Soil	0.062	95.2	98.2	96.9
Mn	12-S8	101.	189.	98.2	89.8
Na	LCS-Soil	2.03	118.	98.2	118.
Na	12-S8	90.4	305.	98.2	218.
Pb	LCS-Soil	< 0.494	95.5	98.2	97.2
Pb	12-S8	1.06	95.8	98.2	96.5
Zr	LCS-Soil	< 0.099	100.	98.2	102.
Zr	12-S8	3.94	93.6	98.2	91.4

*: per EPA CLP protocol, control limits do not apply if spike concentration is less than 25% of the sample concentration

QA/QC Limits
Continuing Calibration: ± 10% *LCS: ± 20%*
Duplicates: ± 20% RPD *Spikes: ± 25%*

Chain of Custody/ Correspondence

CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
503-624-2183
www.chesterlab.net

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10-061312	061312 061412		Comp B Surface	PM10	12-T1805	X	X	X	X	X	X	X				
PS-OD-PM10-062712-02	062712		Comp B Surface	PM10	12-T1852	X	X	X	X	X	X	X				
PS-OD-PM10-061412	061412		Comp B 6feet	PM10	12-T1807	X	X	X	X	X	X	X				
PS-OD-PM10-061512	061512		Comp B 6feet	PM10	12-T1808	X	X	X	X	X	X	X				
PS-OD-PM10-061812-02	061812 061912		V453 6feet	PM10	12-T1815	X	X	X	X	X	X	X				
PS-OD-PM10-062112-01	062112		V453 6feet	PM10	12-T18~~23~~ 26	X	X	X	X	X	X	X				

Requested Analyses	
1	Weight
2	Pb, Ca
3	Zr, Na
4	Mn, Mg
5	Al, K
6	Fe
7	Hf

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/14/12		[signature] 9:10 8/14/12				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM10 Imp

Lab Work Order #

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM10imp-061312	061312 061412		Comp B Surface	7PM10	JA98	X	X	X	X	X	X					12-X1215
PS-OD-PM10imp-062712-02	062712		Comp B Surface	7PM10	JA146	X	X	X	X	X	X					12-X1216
PS-OD-PM10imp-061412	061412 061512		Comp B 6 feet	7PM10	JA100	X	X	X	X	X	X					12-X1217
PS-OD-PM10imp-061512	061512		Comp B 6 feet	7PM10	JA101	X	X	X	X	X	X					12-X1218
PS-OD-PM10imp-061812-02	061812		V453 6 feet	7PM10	JA108	X	X	X	X	X	X					12-X1219
PS-OD-PM10imp-062112-01	062112		V453 6 feet	7PM10	JA119	X	X	X	X	X	X					12-X1220

Requested Analyses

1 Pb, Ca
2 Zr, Na
3 Mn, Mg
4 Al, K
5 Fe
6 Hf
7

Special Instructions/Comments:

Analyze filter and all loose particles in the petri dish

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:
Shipping Tracking #
Specify Turnaround Requirements:

☐ Cooler packed with ice
☐ Cooler custody seal intact

Sample Receipt:
Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
Johnny Hall	8/14/12		[illegible] 8/16/12 9:19				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM 2.5

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5-061312	061312 061412		Comp B Surface	PM 2.5	12-T1301	X	X	X	X	X	X	X				
PS-OD-PM2.5-062712-02	062712		Comp B Surface	PM 2.5	12-T1838	X	X	X	X	X	X	X				
PS-OD-PM2.5-061412	061412 061512		Comp B 6 feet	PM2.5	12-T1303	X	X	X	X	X	X	X				
PS-OD-PM2.5-061512	061512		Comp B 6 feet	PM2.5	12-T1802	X	X	X	X	X	X	X				
PS-OD-PM2.5-061812-02	061812 061912		V453 6 feet	PM2.5	12-T1813	X	X	X	X	X	X	X				
PS-OD-PM2.5-062112-01	062112		V453 6 feet	PM2.5	12-T1818	X	X	X	X	X	X	X				

Requested Analyses	
1	Weight
2	Pb, Cd
3	Zr, Na
4	Mn, Mg
5	Al, K
6	Fe
7	Hf

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/14/12		[signature] 8/16/12 9:10				
Relinquished by:	**DATE**	**TIME**	**Received by:**	**Relinquished by:**	**DATE**	**TIME**	**Received by:**

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

PM2.5 Imp.

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OD-PM2.5 Imp-061312	061312 061412		Comp B Surface	>PM2.5	JA92	X	X	X	X	X	X					12-X1221
PS-OD-PM2.5 Imp-062712-02	062712		Comp B Surface	>PM2.5	JA131	X	X	X	X	X	X					12-X1222
PS-OD-PM2.5 Imp-061412	061412 061512		Comp B 6 feet	>PM2.5	JA94	X	X	X	X	X	X					12-X1223
PS-OD-PM2.5 Imp-061512	061512		Comp B 6 feet	>PM2.5	JA95	X	X	X	X	X	X					12-X1224
PS-OD-PM2.5 Imp-061812-02	061812 061912		V453 6 feet	>PM2.5	JA106	X	X	X	X	X	X					12-X1225
PS-OD-PM2.5 Imp-062112-01	062112		V453 6 feet	>PM2.5	JA111	X	X	X	X	X	X					12-X1226

Requested Analyses	
1	~~Weight~~ Pb, Cd
2	Zr, Na
3	Mn, Mg,
4	Al, K
5	Fe
6	Hf
7	

Special Instructions/Comments:

Analyze filter and all loose particles in the petri dish.

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/14/12		[signature] 8/14/12 9:40				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

Page (of)

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Open Burn

SAMPLERS:

Requested Analyses

SAMPLE ID	DATE	TIME	MATRIX	PM	Filter #	1	2	3	4	5	6	7	8	9	10	Remarks
PS-OB - PM10mp - 062712-01-OR	062712		451	7PM10	JA142		X									Burn # 6-9 12-X1227
PS-OB - PM10mp - 062712 -02-OR	062712		452A	7PM10	JA143		X	X								Burn # 1-4 12-X1228
PS-OB - PM10 - 062712-01-OR	062712		451	PM10	12-T1848	X	X									Burn # 6-9
PS-OB - PM10 - 062712-02-OR	062712		452A	PM10	12-T1849	X	X	X								Burn # 1-4
PS-OB - PM25mp - 062712-01-OR	062712		451	7PM2.5	JA139		X									Burn # 1-5 12-X1229
PS-OB - PM25 - 062712-01-OR	062712		451	PM2.5	12-T1846	X	X									Burn #

Requested Analyses	
1	Weight - post
2	Al
3	Fe
4	
5	
6	
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
John Fell	8/14/12		8.16.12 9:10				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Lab Work Order #

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Soil

SAMPLERS:

SAMPLE ID	DATE	TIME	MATRIX		Jar #	1	2	3	4	5	6	7	8	9	10	Remarks
						Requested Analyses										
BS-Soil-061112	061112		Background, pitt soil		478493	X	X	X	X	X	X	X				12-58
PD-Soil-Comp B-061812	061812		Post Detonation Comp B		255288	X	X	X	X	X	X	X				12-59
BS-Soil-061912	061912		Background, sand fill		255289	X	X	X	X	X	X	X				12-510
PD-Soil-V453-062212	062212		Post detonation V453		478494	X	X	X	X	X	X	X				12-511
PD-Soil-V548-062812	062812		Post Detonation V548			X	X	X	X	X	X	X				12-512

Requested Analyses	
1	Pb, Cd
2	Zr, Na
3	Mn, Mg
4	Al, K
5	Fe
6	Hf
7	

Special Instructions/Comments:

☐ Special QA/QC Instructions

Laboratory Information and Receipt

Lab Name:

Shipping Tracking #

Specify Turnaround Requirements:

☐ Cooler packed with ice

☐ Cooler custody seal intact

Sample Receipt:

Condition/Cooler Temp:

Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:
[signature]	8/6/12		[signature] 9:17 8-7-12				
Relinquished by:	DATE	TIME	Received by:	Relinquished by:	DATE	TIME	Received by:

Paul Duda

From:	Dahman Touati <Touati.Dahman@epamail.epa.gov>
Sent:	Thursday, August 30, 2012 6:18 AM
To:	pduda@chesterlab.net
Cc:	Dennis Tabor
Subject:	Fw: Request for pricing info to work out the PR.

Paul,

Please proceed with the analysis of the samples as follows:

For the 5 Soil samples, Extract with Aqua Regia and analyze for the 10 elements listed on the Chain of Custody,

For the Open Burn Samples (3 Teflon and 3 polycarbonate) Extract with Aqua Regia and analyze for Aluminium and or Iron as listed on the COC

For the 12 samples listed on the PM2.5 Imp and PM10 Imp COCs Aqua Regia Digestion and analyze for the 10 elements on the COC

For the 12 Filters on the PM2.5 and PM10 Please analyze for the full suite of elements reportable including Hf and then take the Four that have the highest amounts of the 10 elements and digest with Aqua Regia and analyze for the 10 elements listed on the COC.

Regards,

Dahman Touati, Ph.D
Certified Project Manager
ARCADIS
Contractor
Tel: (919) 541-3662
Fax:(919) 541-9417
e-mail:dahman.touati@arcadis-us.com
----- Forwarded by Dahman Touati/RTP/USEPA/US on 08/30/2012 09:16 AM -----

From: Dahman Touati/RTP/USEPA/US
To: "pduda@chesterlab.net" <pduda@chesterlab.net>
Cc: "Touati, Dahman" <Dahman.Touati@arcadis-us.com>, Dennis Tabor/RTP/USEPA/US@EPA
Date: 08/27/2012 12:59 PM
Subject: RE: Request for pricing info to work out the PR.

Paul,

Please proceed with the analysis of the soils for the ten metals on the COC and silicon. and analyze the Open Burn samples; these are the samples that include Al, and Fe.

Regards,

Dahman Touati, Ph.D
Certified Project Manager
ARCADIS
Contractor
Tel: (919) 541-3662
Fax:(919) 541-9417

e-mail:dahman.touati@arcadis-us.com

Paul Duda ---08/23/2012 03:52:30 PM---Dennis- We haven't done any experiments comparing HF versus HNO3 digestion efficiency on lead. I ca

From: Paul Duda <pduda@chesterlab.net>
To: Dennis Tabor/RTP/USEPA/US@EPA
Cc: "Touati, Dahman" <Dahman.Touati@arcadis-us.com>
Date: 08/23/2012 03:52 PM
Subject: RE: Request for pricing info to work out the PR.

Dennis-

We haven't done any experiments comparing HF versus HNO3 digestion efficiency on lead. I can tell you that the HF digestion is definitely more vigorous than the standard HNO3 digestion. The HF digestion will completely digest quartz filters while the HNO3 digestion won't dissolve them. The downside is that the HF digestion can cause background problems because the filters can cause matrix interference.

Paul Duda
CHESTER LabNet
(503) 624-2183

From: Dennis Tabor [mailto:Tabor.Dennis@epamail.epa.gov]
Sent: Thursday, August 23, 2012 5:14 AM
To: pduda@chesterlab.net
Cc: dahman.touati@arcadis-us.com
Subject: RE: Request for pricing info to work out the PR.

Paul,

I agree with your reading of the chains of custody except on the three filters for two metals the second metal is called for only on one of the teflon and one of the other. I need another day or so to determine if the HF digestion is going to be applied to the filters instead of the standard digestion. Also remember that all my communication is advisory and the actual contract is not with me. I have copied this communication to Dr. Dahman Touati. He is the one that actually will make the calls.

Have you seen a difference in the results for elements like lead when you do the HF digestion or the HNO3 digestion. Can we compare the results from the HF digestions and the HNO3 digestions?

Thanks

Dennis Tabor
US Environmental Protection Agency (E-343-03)
Office Of Research and Development
National Risk Management Research Laboratory
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

919-541-2686 (Voice) 2413 (Lab) 919-685-3315(Fax)

"Paul Duda" ---08/22/2012 06:21:41 PM---Dennis-

From: "Paul Duda" <pduda@chesterlab.net>
To: Dennis Tabor/RTP/USEPA/US@EPA
Cc: Dahman Touati/RTP/USEPA/US@EPA
Date: 08/22/2012 06:21 PM
Subject: RE: Request for pricing info to work out the PR.

Dennis-

This is getting kind of confusing, yes?

Ok, here is our pricing scheme in a nutshell.

For HF digestion, we charge $70 for the digestion, $20 for the first metal and $10 for additional metals.

For our standard digestion, we charge $15 for the digestion, $15 for the first metal and $10 for additional metals.

We charge extra for the HF because it is dangerous to handle.

Here are a few examples using this pricing-

Soil digested using HF for Si only - $90 (70+20)
Soil with standard digestion for 10 metals - $120 (15+15+9*10)
Filter with standard digestion for 6 metals - $80 (15+15+5*10)

I have attached a scanned copy of the chain of custody. The first 5 pages of the CoC had second pages. The first pages listed 6 of the metals and the second pages listed the other 4. We simply consolidated the information by adding the additional 4 metals from the second pages to the first pages to be more concise. We don't typically get CoC forms with samples listed on 2 pages.

If we've read the CoC properly we have the following in house now:

5 soil samples for 10 metals ($120 per sample)

12 Teflon filters for gravimetry and 10 metals ($120 per sample)
12 filters that we didn't provide for 10 metals ($120 per sample)

3 Teflon filters for gravimetry and 2 metals ($40 per sample)
3 filters that we didn't provide for 2 metals ($40 per sample)

I hope this helps.

Paul Duda
CHESTER LabNet
(503) 624-2183

From: Dennis Tabor [mailto:Tabor.Dennis@epamail.epa.gov]
Sent: Wednesday, August 22, 2012 12:47 PM
To: pduda@chesterlab.net
Subject: Request for pricing info to work out the PR.

Paul,

I think we have figured out some of what we want to do. But I think we need to cover the paperwork first, especially since the actual request will come from Arcadis.

For the soil samples we are going to ask for you to take two samples from the soils and digest one with HF for the silicon analysis and the other with the normal digestion for the other ten elements.

We will also be asking for normal digestion on some of the filters and specifying what elements to look for.

So where we are is that we need to know how to price a 6 metal filter and a two metal filter and a one metal soil for silicon. But this is confusing.

Could you let us know the cost of the digestion of a filter or soil HF or normal, and

Could you let us know the cost of analysis for a sample I think you said $10 per element. but is that the same for one element or 6 from the same sample?

As you probably saw from the COCs there are different batches of filters that get different analyses, so any help to make the process easier would be appreciated.

Thanks

Dennis Tabor
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Office Of Research and Development
National Risk Management Research Laboratory
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

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"Paul Duda" ---08/20/2012 03:30:06 PM---Dennis-

From: "Paul Duda" <pduda@chesterlab.net>
To: Dennis Tabor/RTP/USEPA/US@EPA
Cc: Dahman Touati/RTP/USEPA/US@EPA
Date: 08/20/2012 03:30 PM
Subject: RE: Method citations for your work.

Dennis-

We're not going to do anything more than the filter gravimetry until we get everything figured out. We don't get many requests for Si since it is so prevalent in the environment and there is always a certain amount of background since the spray chamber and torch on our ICP are made of glass. We typically only analyze samples for Si by XRF. We don't have an unexpired standard for Si so Arcadis would need to buy a couple more standards. There is a lot of sand like material in the samples so I'm guessing that the concentrations will be screaming high.

As far as the HF digestion goes, there shouldn't be any problem with any of the requested metals that we know of. The only problem is cost. The price quote I gave was for our standard HNO3/HCl/H2O2 digestion. We can do the **HF digestion,** but it is more expensive, an **extra $60 per sample**. Let me know how to proceed. Thanks.

Paul Duda
CHESTER LabNet
(503) 624-2183

From: Dennis Tabor [mailto:Tabor.Dennis@epamail.epa.gov]
Sent: Monday, August 20, 2012 12:04 PM
To: pduda@chesterlab.net
Subject: RE: Method citations for your work.

Paul,

Just saw this e-mail, and only have a minute to quick respond.

1) All money stuff has to go through Dahman Touati and ARCADIS.

2) I didn't realize you had already gotten samples.

3) I am being asked if you can look for Silicon on these samples and would that required Hydrofluoric acid digestion and would any of the other elements respond badly to a HF digestion?

More Later

Thanks

Dennis Tabor
US Environmental Protection Agency (E-343-03)
Office Of Research and Development
National Risk Management Research Laboratory
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

919-541-2686 (Voice) 2413 (Lab) 919-685-3315(Fax)

"Paul Duda" ---08/20/2012 02:34:47 PM---Dennis-

From: "Paul Duda" <pduda@chesterlab.net>
To: Dennis Tabor/RTP/USEPA/US@EPA
Cc: Dahman Touati/RTP/USEPA/US@EPA
Date: 08/20/2012 02:34 PM
Subject: RE: Method citations for your work.

Dennis-

Sorry for not replying earlier. Your e-mail slipped through the cracks. The only reason I saw it today was because I was trying to figure out if I had any correspondence about the extra 4 metals requested on many of the samples we received late last week. I don't expect any troubles with the metals on your list. I had already ordered a Hf standard since I knew that we didn't have a standard for that. When we received the samples, I realized that we didn't have a Zr standard either. I ordered two on Friday and should receive them on Wednesday.

The cost for the 4 extra metals is $40 per sample. **Is it OK to just charge the extra amount to the PO or will it need to be modified?**

Now, to answer your questions from below:

1. Confirm the Methods that will be used to analyze submitted samples We will use ICP for the metals. Method references would be IO3.1 for the digestion and IO-3.4 for the actual analysis. I can e-mail you our SOPs if you'd like to see them.

2. Does the lab hold NELAP/NELAC certs for specific methods being used? We are NELAC accredited, but not for that method since we have not had enough demand for accrediting it.

3. Will the lab reports provide:

a. Description of the complete QA/QC procedures and results. The report contains all QA/QC results, not the procedures. To what extent of detail were you looking for in the report?

b. Standards results We report all ICVs and CCVs

c. Duplicate results Yes, this is included in the report
c. Spike results. Yes, this is included in the report

e. Media blank results. Yes, this is included in the report, but we only supplied the Teflon filters so that is all we could report. **I would need a couple of filters of the other type to report those blanks.**

f. Instrument calibration data. The calibration data isn't usually reported. We can send the raw data too if you need to see the calibration.

g. Copies of the complete Chains of Custody. Yes, this is included in the report

Paul Duda
CHESTER LabNet
(503) 624-2183

From: Dennis Tabor [mailto:Tabor.Dennis@epamail.epa.gov]
Sent: Friday, August 10, 2012 5:06 AM
To: Paul Duda
Subject: Method citations for your work.

Paul,

As best I know the PR for the next set of work is already to you from ARCADIS. We have had a small change and the project is being broken into two phases and the first phase will be some soils and filters (5 soils and 12 filters I think) for 10 elements for digestion and ICP. The elements are Pb, Zr, Mn, Al, Fe, Hf, Ca, Na, Mg, K do you for see any problem with these elements? We may need to ask Arcadis to adjust the PR to keep you officially notified. It is likely that the last 4 elements will be dropped after the first batch of samples and we will go back to the first six elements in the list.

The reason for this e-mail is to find out the following information.

I have been asked about QC and Reports and Certifications by our data users. I wish this had happened before but most of the information will be just a request for answers. For the last question it is the question of what is currently planned and what would the cost change to If all of these items were included in the report if they were done in the lab. Spikes and duplicates may not have been requested and therefore not reportable. Media blanks may not have been provided to the lab. Could you provide the following information?

1. Confirm the Methods that will be used to analyze submitted samples

2. Does the lab hold NELAP/NELAC certs for specific methods being used?

3. Will the lab reports provide:

a. Description of the complete QA/QC procedures and results.
b. Standards results

c. Duplicate results
c. Spike results.

e. Media blank results.

f. Instrument calibration data.

g. Copies of the complete Chains of Custody.

Thanks

Dennis Tabor
US Environmental Protection Agency (E-343-03)
Office Of Research and Development
National Risk Management Research Laboratory
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

919-541-2686 (Voice) 2413 (Lab) 919-685-3315(Fax)

"Paul Duda" ---01/11/2012 02:20:02 PM---Dennis- The list of metals is below. As I said on the phone, we do not have

From: "Paul Duda" <pduda@chesterlab.net>
To: Dennis Tabor/RTP/USEPA/US@EPA
Date: 01/11/2012 02:20 PM
Subject: RE: Rare earth element analysis by XRF

Dennis-

The list of metals is below. As I said on the phone, we do not have standards for all the obscure metals. A few of them have interpolated calibration factors. The cost for this list would be $100 per sample using standard counting times.

Na
Mg
Al
Si
P
S
Cl
K
Ca
Sc
Ti
V
Cr
Mn
Fe
Co
Ni
Cu
Zn
Ga
Ge
As
Se
Br
Rb
Sr
Y

Zr
Nb
Mo
Rh
Pd
Ag
Cd
In
Sn
Sb
Te
I
Cs
Ba
La
Ce
Pr
Nd
Pm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu
Hf
Ta
W
Ir
Au
Hg
Tl
Pb
Bi

Paul Duda
CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
pduda@chesterlab.net
http:\\www.chesterlab.net
(503)624-2183 ext. 100
fax (503)624-2653

-----Original Message-----
From: Dennis Tabor [mailto:Tabor.Dennis@epamail.epa.gov]
Sent: Wednesday, January 11, 2012 8:56 AM
To: pduda@chesterlab.net
Subject: Rare earth element analysis by XRF

Paul,

I am being asked to get a quote for XRF of filters for Rare earth elements. Does your lab have a standard REE analysis? If so what elements and what would the cost be if we just had 5 filters. I have not asked what size filters these are. Are there only specific sizes that your instruments can do?

Thanks

Dennis Tabor
US Environmental Protection Agency (E-305-01)
Office Of Research and Development
National Risk Management Research Laboratory
109 T.W. Alexander Drive
Research Triangle Park, NC 27711

919-541-2686 (Voice) 2413 (Lab) 919-685-3315(Fax)[attachment "20120822151322702.pdf" deleted by Dennis Tabor/RTP/USEPA/US]

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Paul Duda

From: Dennis Tabor <Tabor.Dennis@epamail.epa.gov>
Sent: Monday, September 10, 2012 6:10 AM
To: dahman.touati@arcadis-us.com
Cc: Dahman Touati; pduda@chesterlab.net; Johanna Aurell
Subject: Re: Samples for ICP?

Follow Up Flag: Follow up
Flag Status: Flagged

Dahman,

Johanna and I have discussed the XRF results and would like to request that Paul do the ICAP on

12-T1808 PS-OD-PM10-061512 PS-OD-PM2.5-061512 PS-OD-PM10-062112-01 12-T1826 and
12-T1805 PS-OD-PM10-061312 12-T1802

10 elements and digest with Aqua Regia and analyze for the 10 elements listed on the COC.

We will then be able to see what we want to do on the rest of the samples.

Thanks

Dennis Tabor
US Environmental Protection Agency (E-343-03)
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"Paul Duda" ---09/05/2012 02:54:26 PM---Dahman-

From: "Paul Duda" <pduda@chesterlab.net>
To: Dahman Touati/RTP/USEPA/US@EPA, <dahman.touati@arcadis-us.com>
Cc: Dennis Tabor/RTP/USEPA/US@EPA
Date: 09/05/2012 02:54 PM
Subject: Samples for ICP?

Dahman-

According to the e-mail I received last week, we are supposed to analyze the 4 highest loaded Teflon filters by ICP. I have attached a spreadsheet version of the data I sent you last week. I sorted the data by net mass. The analytes of interest are in red type. Did you want us to just analyze the samples with the highest net masses or would you like to select different samples based on the XRF results?

I did receive the blank polycarbonate filters and we are moving forward with the analysis on those filters and the soils. The Teflon samples are on hold until I know definitively which samples you'd like analyzed.

Thanks.

Paul Duda
CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
pduda@chesterlab.net
http:\\www.chesterlab.net
(503)624-2183 ext. 100
fax (503)624-2653

[attachment "12-376xrf.xlsx" deleted by Dennis Tabor/RTP/USEPA/US]

I did receive the blank polycarbonate filters and we are moving forward with the analysis on those filters and the soils. The Teflon samples are on hold until I know definitively which samples you'd like analyzed.

Thanks.

Paul Duda
CHESTER LabNet
12242 SW Garden Place
Tigard, OR 97223
pduda@chesterlab.net
http:\\www.chesterlab.net
(503)624-2183 ext. 100
fax (503)624-2653

[attachment "12-376xrf.xlsx" deleted by Dennis Tabor/RTP/USEPA/US]

RAW DATA

Available upon request

Appendix N: Laboratory Report for SUMMA Canister Samples

Columbia Analytical Services
Now part of the ALS Group
2655 Park Center Drive, Suite A, Simi Valley, CA 93065 | 805.526.7161 | www.caslab.com

LABORATORY REPORT

July 24, 2012

Dahman Touati
ARCADIS U.S., Inc.
4915 Prospectus Drive, Suite F
Durham, NC 27713

RE: Air Testing Tooele / 31670

Dear Dahman:

Enclosed is the Tier III report for the samples submitted to our laboratory on July 2, 2012. For your reference, these analyses have been assigned our service request number P1202679.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA200007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L11-203; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-12-3; Minnesota Department of Health, NELAP Certificate No. 362188; Washington State Department of Ecology, ELAP Lab ID: C946, State of Utah Department of Health, NELAP Certificate No. CA015272011-1; Los Angeles Department of Building and Safety, Approval No: TA00001. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

ALS | Environmental

Digitally signed by Sue Anderson
Date: 2012.07.24 09:22:16 -07'00'

Sue Anderson
Project Manager

Client: ARCADIS U.S., Inc. Service Request No: P1202679
Project: Air Testing Tooele / 31670

CASE NARRATIVE

The samples were received intact under chain of custody on July 2, 2012 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Carbon Monoxide and Carbon Dioxide Analysis

The samples were analyzed for carbon monoxide and carbon dioxide according to modified EPA Method 25C. The analyses included a single sample injection (method modification) analyzed by gas chromatography using flame ionization detection/total combustion analysis.

Volatile Organic Compound Analysis

The samples were also analyzed for volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph / mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator. The method was modified to include the use of helium as a diluent gas in place of zero-grade air for canister pressurization. When necessary, analytical sample volumes were adjusted by a correction factor for canisters pressurized with helium. A summary sheet has been included listing the affected samples.

Sample BS-OD-062012 (P1202679-003) required dilution due to the presence of elevated levels of non-target analyte. The reporting limits have been adjusted accordingly.

The upper control criterion was exceeded for 2-Propanol (Isopropyl Alcohol) in the Continuing Calibration Verifications (CCVs) and the Laboratory Control Samples (LCSs) analyzed on July 6, 2012 and July 9, 2012. Since the apparent problem equates to a potential high bias and the field samples analyzed in this sequence did not contain the analyte in question, the data quality is not significantly affected. No corrective action was required.

The Summa canisters were cleaned, prior to sampling, down to the method reporting limit (MRL) reported for this project. Therefore, any result reported below the MRL may be biased high.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. dba ALS Environmental (ALS) is not responsible for utilization of less than the complete report.

Use of Columbia Analytical Services, Inc. dba ALS Environmental (ALS)'s Name. Client shall not use ALS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to AALS any test result, tolerance or specification derived from ALS's data ("Attribution") without ALS's prior written consent, which may be withheld by ALS for any reason in its sole discretion. To request ALS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If ALS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use ALS's name or trademark in any Materials or Attribution shall be deemed denied. ALS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of ALS's name or trademark

may cause ALS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

DETAIL SUMMARY REPORT

Client: ARCADIS U.S., Inc.
Project ID: Air Testing Tooele / 31670

Service Request: P1202679

Date Received: 7/2/2012
Time Received: 10:20

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	25C Modified - TGNMO+ 1X Can	TO-15 - VOC Cans
BS-OD-061412	P1202679-001	Air	6/14/2012	00:00	SC01611	-2.12	3.80	X	X
PS-OD-061612	P1202679-002	Air	6/16/2012	00:00	SC00903	-13.62	4.08	X	X
BS-OD-062012	P1202679-003	Air	6/20/2012	00:00	SC00633	-2.12	3.85	X	X
PS-OD-SC-062112-01	P1202679-004	Air	6/21/2012	00:00	SC01556	-4.66	3.65	X	X
PS-OD-SC-062112-02	P1202679-005	Air	6/21/2012	00:00	SC00314	-5.63	3.56	X	X
PS-OD-SC-062312-01	P1202679-006	Air	6/23/2012	00:00	SC00102	-9.01	3.99	X	X
PS-OD-SC-062512-01	P1202679-007	Air	6/25/2012	00:00	SC01605	-7.69	3.79	X	X
PS-OB-SC-062712-01	P1202679-008	Air	6/27/2012	00:00	SC00166	-2.52	3.56	X	X
PS-OB-SC-062712-02	P1202679-009	Air	6/27/2012	00:00	SC00008	-7.25	3.78	X	X
PS-OD-SC-062712-01	P1202679-010	Air	6/27/2012	00:00	SC01595	-8.81	3.83	X	X
PS-OD-SC-062712-02	P1202679-011	Air	6/27/2012	00:00	SC00109	-3.51	3.54	X	X
BS-OD-SC-062812	P1202679-012	Air	6/28/2012	00:00	SC01577	-2.66	3.50	X	X

Columbia Analytical Services, Inc.
Sample Volume Correction for Helium Pressurization for SCAN Analysis

Sample ID	Pi	Pf	Sample Volume (L)	Adjusted Volume (L)
P1202679-001	-2.12	3.80	1.000	1.12
P1202679-002	-13.62	4.08	0.729	1.00
P1202679-003	-2.12	3.85	0.089	0.100
P1202679-004	-4.66	3.65	0.856	1.00
P1202679-005	-5.63	3.56	0.843	1.00
P1202679-006	-9.01	3.99	0.794	1.00
P1202679-007	-7.69	3.79	0.813	1.00
P1202679-008	-2.52	3.56	0.887	1.00
P1202679-009	-7.25	3.78	0.819	1.00
P1202679-010	-8.81	3.83	0.797	1.00
P1202679-011	-3.51	3.54	0.873	1.00
P1202679-012	-2.66	3.50	0.886	1.00

Validation Date: 10/13/09
Template Name: MFC_GCF_backfill.xls
Printed: 7/16/12

J:\A-GCMS\Helium pressurizationP1202679_He Pressurization_SCAN.xls
1 of 1

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Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

P1202679

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. 31 670

Company Name & Address (Reporting Information): ARCADIS U.S., INC. PO Box 13109, Research Triangle Park, NC 27709

Project Name: Air testing Tovale

Project Number:

CAS Contact: Sue Anderson

Project Manager: Dahman Tovati

P.O. # / Billing Information: R B70911

Phone: 919-541-3662 Fax: 919-541-9417

Email Address for Result Reporting: dahman.tovati@arcadis-us.com

Sampler (Print & Sign): Johanna Averill / Johanna Averill

Analysis Method

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	TO 15	25CM CO CO2	Comments e.g. Actual Preservative or specific instructions
BS-OD-061712	(1) -2.11	061712		SC01611				6L	X	X	
BS-OD-061612	(2) -1.33	061612		SC06503					X	X	Comp B Street
BS-OD-062012	(3) -2.05	062012		SC00633				6L	X	X	
BS-OD-SC-062112-01	(4) -4.54	062112		SC01556		25	5	6L	X	X	warmed 3 feet
BS-OD-SC-06212-02	(5) -5.46	062112		SC00314		25	7	6L	X	X	-"-
BS-OD-SC-062312-01	(6) -5.87	062312		SC00102		25	14	6L	X	X	V 548
BS-OD-SC-062512-01	(7) -7.54	062512		SC01605		25	11	6L	X	X	V 548
BS-OB-SC-062712-01	(8) -2.44	062712		SC00166		25	0	6L	X	X	AP 451
BS-OB-SC-062712-02	(9) -7.07	062712		SC00008		25	11	6L	X	X	AP 452A
BS-OD-SC-062712-01	(10) -8.66	062712		SC01595		25	0	6L	X	X	548
BS-OD-SC-062712-02	(11) -3.41	062712		SC00109		25	0	6L	X	X	Comp B surface
BS-OD-SC-062812	(12) -2.52	062812		SC01577		25	0	6L	X	X	Ambient
	-14.22										
	-14.21 -3										
	14.20 -5										
	-14.15 -2										
	-14.08										
	-13.55										
	-13.54										
	-12.79										
	-8.56										

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) ____
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: _____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Date: 7/6/12	Time: 1070

Cooler / Blank Temperature ____ °C

COC AIR REV 3.11

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Sample Acceptance Check Form

Client: ARCADIS U.S., Inc. Work order: P1202679

Project: Air Testing Tooele

Sample(s) received on: 7/2/12 Date opened: 7/2/12 by: MZAMORA

Note: This form is used forall samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? _____ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1202679-001.01	6.0 L Source Can					
P1202679-002.01	6.0 L Source Can					
P1202679-003.01	6.0 L Source Can					
P1202679-004.01	6.0 L Source Can					
P1202679-005.01	6.0 L Source Can					
P1202679-006.01	6.0 L Source Can					
P1202679-007.01	6.0 L Source Can					
P1202679-008.01	6.0 L Source Can					

Explain any discrepancies: (include lab sample ID numbers): _____

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

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Sample Acceptance Check Form

Client: ARCADIS U.S., Inc. Work order: P1202679

Project: Air Testing Tooele

Sample(s) received on: 7/2/12 Date opened: 7/2/12 by: MZAMORA

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1202679-009.01	6.0 L Source Can					
P1202679-010.01	6.0 L Source Can					
P1202679-011.01	6.0 L Source Can					
P1202679-012.01	6.0 L Source Can					

Explain any discrepancies: (include lab sample ID numbers):

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-061412**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-001

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01611

Date Collected: 6/14/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.80

Canister Dilution Factor: 1.47

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	7.4	0.16	
124-38-9	Carbon Dioxide	**370**	7.4	0.11	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-061612**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-002

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00903

Date Collected: 6/16/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -13.62 Final Pressure (psig): 4.08

Canister Dilution Factor: 17.39

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	**100**	87	1.9	
124-38-9	Carbon Dioxide	**460**	87	1.3	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-062012**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-003

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00633

Date Collected: 6/20/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.85

Canister Dilution Factor: 1.47

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	7.4	0.16	
124-38-9	Carbon Dioxide	**370**	7.4	0.11	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-004

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01556

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -4.66 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.83

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	**15**	9.2	0.20	
124-38-9	Carbon Dioxide	**390**	9.2	0.14	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-005

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00314

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -5.63 Final Pressure (psig): 3.56

Canister Dilution Factor: 2.01

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	**10**	10	0.22	
124-38-9	Carbon Dioxide	**380**	10	0.15	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062312-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-006

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00102

Date Collected: 6/23/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -9.01 Final Pressure (psig): 3.99

Canister Dilution Factor: 3.28

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	**11**	16	0.36	**J**
124-38-9	Carbon Dioxide	**370**	16	0.25	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062512-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-007

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01605

Date Collected: 6/25/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -7.69 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.64

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	**16**	13	0.29	
124-38-9	Carbon Dioxide	**340**	13	0.20	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-008

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00166

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -2.52 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.50

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	7.5	0.17	
124-38-9	Carbon Dioxide	**450**	7.5	0.11	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-009

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00008

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -7.25 Final Pressure (psig): 3.78

Canister Dilution Factor: 2.48

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	12	0.27	
124-38-9	Carbon Dioxide	**400**	12	0.19	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-010

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01595

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -8.81 Final Pressure (psig): 3.83

Canister Dilution Factor: 3.15

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	16	0.35	
124-38-9	Carbon Dioxide	**320**	16	0.24	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-011

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00109

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -3.51 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.63

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	8.2	0.18	
124-38-9	Carbon Dioxide	**330**	8.2	0.12	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-SC-062812**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-012

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01577

Date Collected: 6/28/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 0.50 ml(s)

Initial Pressure (psig): -2.66 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.51

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	7.6	0.17	
124-38-9	Carbon Dioxide	**290**	7.6	0.11	**B**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
B = Analyte detected in both the sample and associated method blank.

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RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-MB

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/06/12
Volume(s) Analyzed: 0.50 ml(s)

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	5.0	0.11	
124-38-9	Carbon Dioxide	ND	5.0	0.075	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-LCS

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/06/12
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	**Result ppmV**	**% Recovery**	CAS Acceptance Limits	Data Qualifier
Carbon Monoxide	99.8	**91.7**	**92**	73-132	
Carbon Dioxide	99.8	**87.2**	**87**	71-123	

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2655 Park Center Drive, Suite A, Simi Valley, CA 93065 | 805.526.7161 | www.caslab.com

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120707-MB

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/07/12
Volume(s) Analyzed: 0.50 ml(s)

CAS #	Compound	Result ppmV	MRL ppmV	MDL ppmV	Data Qualifier
630-08-0	Carbon Monoxide	ND	5.0	0.11	
124-38-9	Carbon Dioxide	**2.6**	5.0	0.075	**J**

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

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LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120707-LCS

Test Code: EPA Method 25C Modified
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Wade Henton
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/07/12
Volume(s) Analyzed: NA ml(s)

Compound	Spike Amount ppmV	**Result ppmV**	**% Recovery**	CAS Acceptance Limits	Data Qualifier
Carbon Monoxide	99.8	**100**	**100**	73-132	
Carbon Dioxide	99.8	**92.2**	**92**	71-123	

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-061412**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-001

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01611

Date Collected: 6/14/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.12 Liter(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.80

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**0.59**	0.66	0.17	**0.34**	0.38	0.099	J
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	0.66	0.18	**0.52**	0.13	0.037	
74-87-3	Chloromethane	**0.43**	0.66	0.20	**0.21**	0.32	0.095	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.66	0.18	ND	0.094	0.026	
75-01-4	Vinyl Chloride	ND	0.66	0.20	ND	0.26	0.077	
106-99-0	1,3-Butadiene	ND	0.66	0.21	ND	0.30	0.095	
74-83-9	Bromomethane	ND	0.66	0.18	ND	0.17	0.047	
75-00-3	Chloroethane	ND	0.66	0.18	ND	0.25	0.070	
64-17-5	Ethanol	**1.2**	6.6	1.2	**0.66**	3.5	0.64	J
75-05-8	Acetonitrile	ND	0.66	0.32	ND	0.39	0.19	
107-02-8	Acrolein	**0.79**	2.6	0.26	**0.34**	1.1	0.11	J
67-64-1	Acetone	**19**	6.6	1.4	**8.2**	2.8	0.61	
75-69-4	Trichlorofluoromethane	**1.3**	0.66	0.17	**0.23**	0.12	0.030	
67-63-0	2-Propanol (Isopropyl Alcohol)	**0.81**	6.6	0.45	**0.33**	2.7	0.18	J
107-13-1	Acrylonitrile	ND	0.66	0.24	ND	0.30	0.11	
75-35-4	1,1-Dichloroethene	ND	0.66	0.21	ND	0.17	0.053	
75-09-2	Methylene Chloride	**0.42**	0.66	0.20	**0.12**	0.19	0.057	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.66	0.18	ND	0.21	0.059	
76-13-1	Trichlorotrifluoroethane	**0.60**	0.66	0.26	**0.078**	0.086	0.034	J
75-15-0	Carbon Disulfide	**0.55**	6.6	0.17	**0.18**	2.1	0.055	J
156-60-5	trans-1,2-Dichloroethene	ND	0.66	0.20	ND	0.17	0.050	
75-34-3	1,1-Dichloroethane	ND	0.66	0.18	ND	0.16	0.045	
1634-04-4	Methyl tert-Butyl Ether	ND	0.66	0.18	ND	0.18	0.051	
108-05-4	Vinyl Acetate	ND	6.6	0.79	ND	1.9	0.22	
78-93-3	2-Butanone (MEK)	**1.8**	6.6	0.26	**0.61**	2.2	0.089	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-061412**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-001

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01611

Date Collected: 6/14/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.12 Liter(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.80

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.66	0.21	ND	0.17	0.053	
141-78-6	Ethyl Acetate	ND	1.3	0.42	ND	0.36	0.12	
110-54-3	n-Hexane	ND	0.66	0.21	ND	0.19	0.060	
67-66-3	Chloroform	ND	0.66	0.18	ND	0.13	0.038	
109-99-9	Tetrahydrofuran (THF)	ND	0.66	0.34	ND	0.22	0.12	
107-06-2	1,2-Dichloroethane	ND	0.66	0.18	ND	0.16	0.045	
71-55-6	1,1,1-Trichloroethane	ND	0.66	0.18	ND	0.12	0.034	
71-43-2	Benzene	ND	0.66	0.18	ND	0.21	0.058	
56-23-5	Carbon Tetrachloride	**0.39**	0.66	0.20	**0.062**	0.10	0.031	J
110-82-7	Cyclohexane	ND	1.3	0.34	ND	0.38	0.099	
78-87-5	1,2-Dichloropropane	ND	0.66	0.18	ND	0.14	0.040	
75-27-4	Bromodichloromethane	ND	0.66	0.20	ND	0.098	0.029	
79-01-6	Trichloroethene	ND	0.66	0.18	ND	0.12	0.034	
123-91-1	1,4-Dioxane	ND	0.66	0.18	ND	0.18	0.051	
80-62-6	Methyl Methacrylate	ND	1.3	0.34	ND	0.32	0.083	
142-82-5	n-Heptane	ND	0.66	0.18	ND	0.16	0.045	
10061-01-5	cis-1,3-Dichloropropene	ND	0.66	0.17	ND	0.14	0.038	
108-10-1	4-Methyl-2-pentanone	**0.42**	0.66	0.21	**0.10**	0.16	0.051	J
10061-02-6	trans-1,3-Dichloropropene	ND	0.66	0.17	ND	0.14	0.038	
79-00-5	1,1,2-Trichloroethane	ND	0.66	0.17	ND	0.12	0.031	
108-88-3	Toluene	**1.0**	0.66	0.18	**0.27**	0.17	0.049	
591-78-6	2-Hexanone	**0.32**	0.66	0.25	**0.079**	0.16	0.061	J
124-48-1	Dibromochloromethane	ND	0.66	0.20	ND	0.077	0.023	
106-93-4	1,2-Dibromoethane	ND	0.66	0.20	ND	0.085	0.026	
123-86-4	n-Butyl Acetate	ND	0.66	0.24	ND	0.14	0.050	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
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J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-061412**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-001

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01611

Date Collected: 6/14/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.12 Liter(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.80

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.66	0.18	ND	0.14	0.039	
127-18-4	Tetrachloroethene	ND	0.66	0.16	ND	0.097	0.023	
108-90-7	Chlorobenzene	ND	0.66	0.20	ND	0.14	0.043	
100-41-4	Ethylbenzene	ND	0.66	0.20	ND	0.15	0.045	
179601-23-1	m,p-Xylenes	ND	1.3	0.38	ND	0.30	0.088	
75-25-2	Bromoform	ND	0.66	0.21	ND	0.063	0.020	
100-42-5	Styrene	ND	0.66	0.20	ND	0.15	0.046	
95-47-6	o-Xylene	ND	0.66	0.21	ND	0.15	0.048	
111-84-2	n-Nonane	ND	0.66	0.18	ND	0.13	0.035	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.66	0.20	ND	0.096	0.029	
98-82-8	Cumene	ND	0.66	0.18	ND	0.13	0.037	
80-56-8	alpha-Pinene	ND	0.66	0.18	ND	0.12	0.033	
103-65-1	n-Propylbenzene	ND	0.66	0.22	ND	0.13	0.045	
622-96-8	4-Ethyltoluene	ND	0.66	0.20	ND	0.13	0.040	
108-67-8	1,3,5-Trimethylbenzene	ND	0.66	0.20	ND	0.13	0.040	
95-63-6	1,2,4-Trimethylbenzene	ND	0.66	0.20	ND	0.13	0.040	
100-44-7	Benzyl Chloride	ND	0.66	0.20	ND	0.13	0.038	
541-73-1	1,3-Dichlorobenzene	ND	0.66	0.18	ND	0.11	0.031	
106-46-7	1,4-Dichlorobenzene	ND	0.66	0.20	ND	0.11	0.033	
95-50-1	1,2-Dichlorobenzene	ND	0.66	0.21	ND	0.11	0.035	
5989-27-5	d-Limonene	**0.38**	0.66	0.22	**0.069**	0.12	0.040	**J**
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.66	0.18	ND	0.068	0.019	
120-82-1	1,2,4-Trichlorobenzene	ND	0.66	0.24	ND	0.088	0.032	
91-20-3	Naphthalene	ND	0.66	0.28	ND	0.13	0.053	
87-68-3	Hexachlorobutadiene	ND	0.66	0.18	ND	0.062	0.017	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-061612**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-002

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00903

Date Collected: 6/16/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -13.62 Final Pressure (psig): 4.08

Canister Dilution Factor: 17.39

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**48**	8.7	2.3	**28**	5.1	1.3	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	8.7	2.4	**0.52**	1.8	0.49	J
74-87-3	Chloromethane	ND	8.7	2.6	ND	4.2	1.3	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	8.7	2.4	ND	1.2	0.35	
75-01-4	Vinyl Chloride	ND	8.7	2.6	ND	3.4	1.0	
106-99-0	1,3-Butadiene	ND	8.7	2.8	ND	3.9	1.3	
74-83-9	Bromomethane	ND	8.7	2.4	ND	2.2	0.63	
75-00-3	Chloroethane	ND	8.7	2.4	ND	3.3	0.92	
64-17-5	Ethanol	**18**	87	16	**9.6**	46	8.5	J
75-05-8	Acetonitrile	**150**	8.7	4.2	**92**	5.2	2.5	
107-02-8	Acrolein	**5.6**	35	3.5	**2.5**	15	1.5	J
67-64-1	Acetone	**170**	87	19	**72**	37	8.1	
75-69-4	Trichlorofluoromethane	ND	8.7	2.3	ND	1.5	0.40	
67-63-0	2-Propanol (Isopropyl Alcohol)	**53**	87	5.9	**21**	35	2.4	J
107-13-1	Acrylonitrile	ND	8.7	3.1	ND	4.0	1.4	
75-35-4	1,1-Dichloroethene	ND	8.7	2.8	ND	2.2	0.70	
75-09-2	Methylene Chloride	**3.4**	8.7	2.6	**0.97**	2.5	0.75	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	8.7	2.4	ND	2.8	0.78	
76-13-1	Trichlorotrifluoroethane	ND	8.7	3.5	ND	1.1	0.45	
75-15-0	Carbon Disulfide	**9.7**	87	2.3	**3.1**	28	0.73	J
156-60-5	trans-1,2-Dichloroethene	ND	8.7	2.6	ND	2.2	0.66	
75-34-3	1,1-Dichloroethane	ND	8.7	2.4	ND	2.1	0.60	
1634-04-4	Methyl tert-Butyl Ether	ND	8.7	2.4	ND	2.4	0.68	
108-05-4	Vinyl Acetate	ND	87	10	ND	25	3.0	
78-93-3	2-Butanone (MEK)	**11**	87	3.5	**3.6**	29	1.2	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-061612** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P1202679-002

Test Code: EPA TO-15 Modified Date Collected: 6/16/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 7/2/12
Analyst: Wida Ang Date Analyzed: 7/6/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: SC00903

Initial Pressure (psig): -13.62 Final Pressure (psig): 4.08

Canister Dilution Factor: 17.39

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	8.7	2.8	ND	2.2	0.70	
141-78-6	Ethyl Acetate	ND	17	5.6	ND	4.8	1.5	
110-54-3	n-Hexane	ND	8.7	2.8	ND	2.5	0.79	
67-66-3	Chloroform	ND	8.7	2.4	ND	1.8	0.50	
109-99-9	Tetrahydrofuran (THF)	ND	8.7	4.5	ND	2.9	1.5	
107-06-2	1,2-Dichloroethane	ND	8.7	2.4	ND	2.1	0.60	
71-55-6	1,1,1-Trichloroethane	ND	8.7	2.4	ND	1.6	0.45	
71-43-2	Benzene	**33**	8.7	2.4	**10**	2.7	0.76	
56-23-5	Carbon Tetrachloride	ND	8.7	2.6	ND	1.4	0.41	
110-82-7	Cyclohexane	ND	17	4.5	ND	5.1	1.3	
78-87-5	1,2-Dichloropropane	ND	8.7	2.4	ND	1.9	0.53	
75-27-4	Bromodichloromethane	ND	8.7	2.6	ND	1.3	0.39	
79-01-6	Trichloroethene	ND	8.7	2.4	ND	1.6	0.45	
123-91-1	1,4-Dioxane	ND	8.7	2.4	ND	2.4	0.68	
80-62-6	Methyl Methacrylate	ND	17	4.5	ND	4.2	1.1	
142-82-5	n-Heptane	ND	8.7	2.4	ND	2.1	0.59	
10061-01-5	cis-1,3-Dichloropropene	ND	8.7	2.3	ND	1.9	0.50	
108-10-1	4-Methyl-2-pentanone	**4.9**	8.7	2.8	**1.2**	2.1	0.68	J
10061-02-6	trans-1,3-Dichloropropene	ND	8.7	2.3	ND	1.9	0.50	
79-00-5	1,1,2-Trichloroethane	ND	8.7	2.3	ND	1.6	0.41	
108-88-3	Toluene	**15**	8.7	2.4	**3.9**	2.3	0.65	
591-78-6	2-Hexanone	ND	8.7	3.3	ND	2.1	0.81	
124-48-1	Dibromochloromethane	ND	8.7	2.6	ND	1.0	0.31	
106-93-4	1,2-Dibromoethane	ND	8.7	2.6	ND	1.1	0.34	
123-86-4	n-Butyl Acetate	ND	8.7	3.1	ND	1.8	0.66	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-061612**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-002

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00903

Date Collected: 6/16/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -13.62 Final Pressure (psig): 4.08

Canister Dilution Factor: 17.39

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	8.7	2.4	ND	1.9	0.52	
127-18-4	Tetrachloroethene	ND	8.7	2.1	ND	1.3	0.31	
108-90-7	Chlorobenzene	ND	8.7	2.6	ND	1.9	0.57	
100-41-4	Ethylbenzene	ND	8.7	2.6	ND	2.0	0.60	
179601-23-1	m,p-Xylenes	**6.5**	17	5.0	**1.5**	4.0	1.2	J
75-25-2	Bromoform	ND	8.7	2.8	ND	0.84	0.27	
100-42-5	Styrene	ND	8.7	2.6	ND	2.0	0.61	
95-47-6	o-Xylene	ND	8.7	2.8	ND	2.0	0.64	
111-84-2	n-Nonane	**2.9**	8.7	2.4	**0.55**	1.7	0.46	J
79-34-5	1,1,2,2-Tetrachloroethane	ND	8.7	2.6	ND	1.3	0.38	
98-82-8	Cumene	ND	8.7	2.4	ND	1.8	0.50	
80-56-8	alpha-Pinene	ND	8.7	2.4	ND	1.6	0.44	
103-65-1	n-Propylbenzene	ND	8.7	3.0	ND	1.8	0.60	
622-96-8	4-Ethyltoluene	ND	8.7	2.6	ND	1.8	0.53	
108-67-8	1,3,5-Trimethylbenzene	ND	8.7	2.6	ND	1.8	0.53	
95-63-6	1,2,4-Trimethylbenzene	**3.5**	8.7	2.6	**0.70**	1.8	0.53	J
100-44-7	Benzyl Chloride	ND	8.7	2.6	ND	1.7	0.50	
541-73-1	1,3-Dichlorobenzene	ND	8.7	2.4	ND	1.4	0.41	
106-46-7	1,4-Dichlorobenzene	ND	8.7	2.6	ND	1.4	0.43	
95-50-1	1,2-Dichlorobenzene	ND	8.7	2.8	ND	1.4	0.46	
5989-27-5	d-Limonene	ND	8.7	3.0	ND	1.6	0.53	
96-12-8	1,2-Dibromo-3-chloropropane	ND	8.7	2.4	ND	0.90	0.25	
120-82-1	1,2,4-Trichlorobenzene	ND	8.7	3.1	ND	1.2	0.42	
91-20-3	Naphthalene	ND	8.7	3.7	ND	1.7	0.70	
87-68-3	Hexachlorobutadiene	ND	8.7	2.4	ND	0.82	0.23	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-062012**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-003

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00633

Date Collected: 6/20/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.10 Liter(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.85

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	ND	7.4	1.9	ND	4.3	1.1	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	7.4	2.1	**0.52**	1.5	0.42	J
74-87-3	Chloromethane	**2.8**	7.4	2.2	**1.4**	3.6	1.1	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	7.4	2.1	ND	1.1	0.29	
75-01-4	Vinyl Chloride	ND	7.4	2.2	ND	2.9	0.86	
106-99-0	1,3-Butadiene	ND	7.4	2.4	ND	3.3	1.1	
74-83-9	Bromomethane	ND	7.4	2.1	ND	1.9	0.53	
75-00-3	Chloroethane	ND	7.4	2.1	ND	2.8	0.78	
64-17-5	Ethanol	ND	74	14	ND	39	7.2	
75-05-8	Acetonitrile	ND	7.4	3.5	ND	4.4	2.1	
107-02-8	Acrolein	ND	29	2.9	ND	13	1.3	
67-64-1	Acetone	**17**	74	16	**7.1**	31	6.8	J
75-69-4	Trichlorofluoromethane	ND	7.4	1.9	ND	1.3	0.34	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	74	5.0	ND	30	2.0	
107-13-1	Acrylonitrile	ND	7.4	2.6	ND	3.4	1.2	
75-35-4	1,1-Dichloroethene	ND	7.4	2.4	ND	1.9	0.59	
75-09-2	Methylene Chloride	**3.1**	7.4	2.2	**0.88**	2.1	0.63	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	7.4	2.1	ND	2.3	0.66	
76-13-1	Trichlorotrifluoroethane	ND	7.4	2.9	ND	0.96	0.38	
75-15-0	Carbon Disulfide	**2.0**	74	1.9	**0.63**	24	0.61	J
156-60-5	trans-1,2-Dichloroethene	ND	7.4	2.2	ND	1.9	0.56	
75-34-3	1,1-Dichloroethane	ND	7.4	2.1	ND	1.8	0.51	
1634-04-4	Methyl tert-Butyl Ether	ND	7.4	2.1	ND	2.0	0.57	
108-05-4	Vinyl Acetate	ND	74	8.8	ND	21	2.5	
78-93-3	2-Butanone (MEK)	ND	74	2.9	ND	25	1.0	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-062012** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P1202679-003

Test Code: EPA TO-15 Modified Date Collected: 6/20/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 7/2/12
Analyst: Wida Ang Date Analyzed: 7/6/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 0.10 Liter(s)
Test Notes:
Container ID: SC00633

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.85

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	7.4	2.4	ND	1.9	0.59	
141-78-6	Ethyl Acetate	ND	15	4.7	ND	4.1	1.3	
110-54-3	n-Hexane	ND	7.4	2.4	ND	2.1	0.67	
67-66-3	Chloroform	ND	7.4	2.1	ND	1.5	0.42	
109-99-9	Tetrahydrofuran (THF)	ND	7.4	3.8	ND	2.5	1.3	
107-06-2	1,2-Dichloroethane	ND	7.4	2.1	ND	1.8	0.51	
71-55-6	1,1,1-Trichloroethane	ND	7.4	2.1	ND	1.3	0.38	
71-43-2	Benzene	ND	7.4	2.1	ND	2.3	0.64	
56-23-5	Carbon Tetrachloride	ND	7.4	2.2	ND	1.2	0.35	
110-82-7	Cyclohexane	ND	15	3.8	ND	4.3	1.1	
78-87-5	1,2-Dichloropropane	ND	7.4	2.1	ND	1.6	0.45	
75-27-4	Bromodichloromethane	ND	7.4	2.2	ND	1.1	0.33	
79-01-6	Trichloroethene	ND	7.4	2.1	ND	1.4	0.38	
123-91-1	1,4-Dioxane	ND	7.4	2.1	ND	2.0	0.57	
80-62-6	Methyl Methacrylate	ND	15	3.8	ND	3.6	0.93	
142-82-5	n-Heptane	ND	7.4	2.1	ND	1.8	0.50	
10061-01-5	cis-1,3-Dichloropropene	ND	7.4	1.9	ND	1.6	0.42	
108-10-1	4-Methyl-2-pentanone	ND	7.4	2.4	ND	1.8	0.57	
10061-02-6	trans-1,3-Dichloropropene	ND	7.4	1.9	ND	1.6	0.42	
79-00-5	1,1,2-Trichloroethane	ND	7.4	1.9	ND	1.3	0.35	
108-88-3	Toluene	ND	7.4	2.1	ND	2.0	0.55	
591-78-6	2-Hexanone	ND	7.4	2.8	ND	1.8	0.68	
124-48-1	Dibromochloromethane	ND	7.4	2.2	ND	0.86	0.26	
106-93-4	1,2-Dibromoethane	ND	7.4	2.2	ND	0.96	0.29	
123-86-4	n-Butyl Acetate	ND	7.4	2.6	ND	1.5	0.56	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-062012**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-003

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00633

Date Collected: 6/20/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 0.10 Liter(s)

Initial Pressure (psig): -2.12 Final Pressure (psig): 3.85

Canister Dilution Factor: 1.47

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	7.4	2.1	ND	1.6	0.44	
127-18-4	Tetrachloroethene	ND	7.4	1.8	ND	1.1	0.26	
108-90-7	Chlorobenzene	ND	7.4	2.2	ND	1.6	0.48	
100-41-4	Ethylbenzene	ND	7.4	2.2	ND	1.7	0.51	
179601-23-1	m,p-Xylenes	ND	15	4.3	ND	3.4	0.98	
75-25-2	Bromoform	ND	7.4	2.4	ND	0.71	0.23	
100-42-5	Styrene	ND	7.4	2.2	ND	1.7	0.52	
95-47-6	o-Xylene	ND	7.4	2.4	ND	1.7	0.54	
111-84-2	n-Nonane	ND	7.4	2.1	ND	1.4	0.39	
79-34-5	1,1,2,2-Tetrachloroethane	ND	7.4	2.2	ND	1.1	0.32	
98-82-8	Cumene	ND	7.4	2.1	ND	1.5	0.42	
80-56-8	alpha-Pinene	ND	7.4	2.1	ND	1.3	0.37	
103-65-1	n-Propylbenzene	ND	7.4	2.5	ND	1.5	0.51	
622-96-8	4-Ethyltoluene	ND	7.4	2.2	ND	1.5	0.45	
108-67-8	1,3,5-Trimethylbenzene	ND	7.4	2.2	ND	1.5	0.45	
95-63-6	1,2,4-Trimethylbenzene	ND	7.4	2.2	ND	1.5	0.45	
100-44-7	Benzyl Chloride	ND	7.4	2.2	ND	1.4	0.43	
541-73-1	1,3-Dichlorobenzene	ND	7.4	2.1	ND	1.2	0.34	
106-46-7	1,4-Dichlorobenzene	ND	7.4	2.2	ND	1.2	0.37	
95-50-1	1,2-Dichlorobenzene	ND	7.4	2.4	ND	1.2	0.39	
5989-27-5	d-Limonene	ND	7.4	2.5	ND	1.3	0.45	
96-12-8	1,2-Dibromo-3-chloropropane	ND	7.4	2.1	ND	0.76	0.21	
120-82-1	1,2,4-Trichlorobenzene	ND	7.4	2.6	ND	0.99	0.36	
91-20-3	Naphthalene	ND	7.4	3.1	ND	1.4	0.59	
87-68-3	Hexachlorobutadiene	ND	7.4	2.1	ND	0.69	0.19	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-004

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01556

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.66 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.83

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**6.2**	0.92	0.24	**3.6**	0.53	0.14	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.7**	0.92	0.26	**0.54**	0.19	0.052	
74-87-3	Chloromethane	**1.1**	0.92	0.27	**0.54**	0.44	0.13	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.92	0.26	ND	0.13	0.037	
75-01-4	Vinyl Chloride	ND	0.92	0.27	ND	0.36	0.11	
106-99-0	1,3-Butadiene	**1.6**	0.92	0.29	**0.73**	0.41	0.13	
74-83-9	Bromomethane	**2.4**	0.92	0.26	**0.61**	0.24	0.066	
75-00-3	Chloroethane	ND	0.92	0.26	ND	0.35	0.097	
64-17-5	Ethanol	**2.6**	9.2	1.7	**1.4**	4.9	0.89	J
75-05-8	Acetonitrile	**52**	0.92	0.44	**31**	0.55	0.26	
107-02-8	Acrolein	**4.9**	3.7	0.37	**2.1**	1.6	0.16	
67-64-1	Acetone	**26**	9.2	2.0	**11**	3.9	0.85	
75-69-4	Trichlorofluoromethane	**1.3**	0.92	0.24	**0.24**	0.16	0.042	
67-63-0	2-Propanol (Isopropyl Alcohol)	**0.91**	9.2	0.62	**0.37**	3.7	0.25	J
107-13-1	Acrylonitrile	**6.6**	0.92	0.33	**3.0**	0.42	0.15	
75-35-4	1,1-Dichloroethene	ND	0.92	0.29	ND	0.23	0.074	
75-09-2	Methylene Chloride	**0.71**	0.92	0.27	**0.20**	0.26	0.079	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.92	0.26	ND	0.29	0.082	
76-13-1	Trichlorotrifluoroethane	**0.59**	0.92	0.37	**0.078**	0.12	0.048	J
75-15-0	Carbon Disulfide	**0.88**	9.2	0.24	**0.28**	2.9	0.076	J
156-60-5	trans-1,2-Dichloroethene	ND	0.92	0.27	ND	0.23	0.069	
75-34-3	1,1-Dichloroethane	ND	0.92	0.26	ND	0.23	0.063	
1634-04-4	Methyl tert-Butyl Ether	ND	0.92	0.26	ND	0.25	0.071	
108-05-4	Vinyl Acetate	**3.2**	9.2	1.1	**0.90**	2.6	0.31	J
78-93-3	2-Butanone (MEK)	**3.8**	9.2	0.37	**1.3**	3.1	0.12	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-01** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P1202679-004

Test Code: EPA TO-15 Modified Date Collected: 6/21/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 7/2/12
Analyst: Wida Ang Date Analyzed: 7/6/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: SC01556

Initial Pressure (psig): -4.66 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.83

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.92	0.29	ND	0.23	0.074	
141-78-6	Ethyl Acetate	ND	1.8	0.59	ND	0.51	0.16	
110-54-3	n-Hexane	ND	0.92	0.29	ND	0.26	0.083	
67-66-3	Chloroform	ND	0.92	0.26	ND	0.19	0.052	
109-99-9	Tetrahydrofuran (THF)	ND	0.92	0.48	ND	0.31	0.16	
107-06-2	1,2-Dichloroethane	ND	0.92	0.26	ND	0.23	0.063	
71-55-6	1,1,1-Trichloroethane	ND	0.92	0.26	ND	0.17	0.047	
71-43-2	Benzene	**17**	0.92	0.26	**5.4**	0.29	0.080	
56-23-5	Carbon Tetrachloride	**0.52**	0.92	0.27	**0.083**	0.15	0.044	J
110-82-7	Cyclohexane	ND	1.8	0.48	ND	0.53	0.14	
78-87-5	1,2-Dichloropropane	ND	0.92	0.26	ND	0.20	0.055	
75-27-4	Bromodichloromethane	ND	0.92	0.27	ND	0.14	0.041	
79-01-6	Trichloroethene	ND	0.92	0.26	ND	0.17	0.048	
123-91-1	1,4-Dioxane	ND	0.92	0.26	ND	0.25	0.071	
80-62-6	Methyl Methacrylate	ND	1.8	0.48	ND	0.45	0.12	
142-82-5	n-Heptane	ND	0.92	0.26	ND	0.22	0.063	
10061-01-5	cis-1,3-Dichloropropene	ND	0.92	0.24	ND	0.20	0.052	
108-10-1	4-Methyl-2-pentanone	**0.53**	0.92	0.29	**0.13**	0.22	0.071	J
10061-02-6	trans-1,3-Dichloropropene	ND	0.92	0.24	ND	0.20	0.052	
79-00-5	1,1,2-Trichloroethane	ND	0.92	0.24	ND	0.17	0.044	
108-88-3	Toluene	**3.8**	0.92	0.26	**1.0**	0.24	0.068	
591-78-6	2-Hexanone	**0.64**	0.92	0.35	**0.16**	0.22	0.085	J
124-48-1	Dibromochloromethane	ND	0.92	0.27	ND	0.11	0.032	
106-93-4	1,2-Dibromoethane	ND	0.92	0.27	ND	0.12	0.036	
123-86-4	n-Butyl Acetate	ND	0.92	0.33	ND	0.19	0.069	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-004

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01556

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -4.66 Final Pressure (psig): 3.65

Canister Dilution Factor: 1.83

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.92	0.26	ND	0.20	0.055	
127-18-4	Tetrachloroethene	ND	0.92	0.22	ND	0.13	0.032	
108-90-7	Chlorobenzene	ND	0.92	0.27	ND	0.20	0.060	
100-41-4	Ethylbenzene	**0.34**	0.92	0.27	**0.078**	0.21	0.063	J
179601-23-1	m,p-Xylenes	ND	1.8	0.53	ND	0.42	0.12	
75-25-2	Bromoform	ND	0.92	0.29	ND	0.089	0.028	
100-42-5	Styrene	**0.92**	0.92	0.27	**0.22**	0.21	0.064	
95-47-6	o-Xylene	ND	0.92	0.29	ND	0.21	0.067	
111-84-2	n-Nonane	ND	0.92	0.26	ND	0.17	0.049	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.92	0.27	ND	0.13	0.040	
98-82-8	Cumene	ND	0.92	0.26	ND	0.19	0.052	
80-56-8	alpha-Pinene	ND	0.92	0.26	ND	0.16	0.046	
103-65-1	n-Propylbenzene	ND	0.92	0.31	ND	0.19	0.063	
622-96-8	4-Ethyltoluene	ND	0.92	0.27	ND	0.19	0.056	
108-67-8	1,3,5-Trimethylbenzene	ND	0.92	0.27	ND	0.19	0.056	
95-63-6	1,2,4-Trimethylbenzene	ND	0.92	0.27	ND	0.19	0.056	
100-44-7	Benzyl Chloride	ND	0.92	0.27	ND	0.18	0.053	
541-73-1	1,3-Dichlorobenzene	ND	0.92	0.26	ND	0.15	0.043	
106-46-7	1,4-Dichlorobenzene	ND	0.92	0.27	ND	0.15	0.046	
95-50-1	1,2-Dichlorobenzene	ND	0.92	0.29	ND	0.15	0.049	
5989-27-5	d-Limonene	**0.57**	0.92	0.31	**0.10**	0.16	0.056	J
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.92	0.26	ND	0.095	0.027	
120-82-1	1,2,4-Trichlorobenzene	ND	0.92	0.33	ND	0.12	0.044	
91-20-3	Naphthalene	**0.39**	0.92	0.38	**0.075**	0.17	0.073	J
87-68-3	Hexachlorobutadiene	ND	0.92	0.26	ND	0.086	0.024	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-005

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00314

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -5.63 Final Pressure (psig): 3.56

Canister Dilution Factor: 2.01

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**7.3**	1.0	0.26	**4.3**	0.58	0.15	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	1.0	0.28	**0.53**	0.20	0.057	
74-87-3	Chloromethane	**1.0**	1.0	0.30	**0.49**	0.49	0.15	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.0	0.28	ND	0.14	0.040	
75-01-4	Vinyl Chloride	ND	1.0	0.30	ND	0.39	0.12	
106-99-0	1,3-Butadiene	**1.4**	1.0	0.32	**0.63**	0.45	0.15	
74-83-9	Bromomethane	ND	1.0	0.28	ND	0.26	0.072	
75-00-3	Chloroethane	ND	1.0	0.28	ND	0.38	0.11	
64-17-5	Ethanol	**18**	10	1.8	**9.6**	5.3	0.98	
75-05-8	Acetonitrile	**33**	1.0	0.48	**20**	0.60	0.29	
107-02-8	Acrolein	**1.7**	4.0	0.40	**0.73**	1.8	0.18	J
67-64-1	Acetone	**30**	10	2.2	**13**	4.2	0.93	
75-69-4	Trichlorofluoromethane	**1.4**	1.0	0.26	**0.25**	0.18	0.047	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	10	0.68	ND	4.1	0.28	
107-13-1	Acrylonitrile	**4.4**	1.0	0.36	**2.0**	0.46	0.17	
75-35-4	1,1-Dichloroethene	ND	1.0	0.32	ND	0.25	0.081	
75-09-2	Methylene Chloride	**0.98**	1.0	0.30	**0.28**	0.29	0.087	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.0	0.28	ND	0.32	0.090	
76-13-1	Trichlorotrifluoroethane	**0.61**	1.0	0.40	**0.080**	0.13	0.052	J
75-15-0	Carbon Disulfide	**1.1**	10	0.26	**0.36**	3.2	0.084	J
156-60-5	trans-1,2-Dichloroethene	**1.3**	1.0	0.30	**0.32**	0.25	0.076	
75-34-3	1,1-Dichloroethane	ND	1.0	0.28	ND	0.25	0.070	
1634-04-4	Methyl tert-Butyl Ether	ND	1.0	0.28	ND	0.28	0.078	
108-05-4	Vinyl Acetate	**1.9**	10	1.2	**0.54**	2.9	0.34	J
78-93-3	2-Butanone (MEK)	**6.0**	10	0.40	**2.0**	3.4	0.14	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-005

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00314

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -5.63 Final Pressure (psig): 3.56

Canister Dilution Factor: 2.01

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	1.0	0.32	ND	0.25	0.081	
141-78-6	Ethyl Acetate	**4.4**	2.0	0.64	**1.2**	0.56	0.18	
110-54-3	n-Hexane	**1.1**	1.0	0.32	**0.32**	0.29	0.091	
67-66-3	Chloroform	ND	1.0	0.28	ND	0.21	0.058	
109-99-9	Tetrahydrofuran (THF)	**4.6**	1.0	0.52	**1.6**	0.34	0.18	
107-06-2	1,2-Dichloroethane	ND	1.0	0.28	ND	0.25	0.070	
71-55-6	1,1,1-Trichloroethane	ND	1.0	0.28	ND	0.18	0.052	
71-43-2	Benzene	**14**	1.0	0.28	**4.3**	0.31	0.088	
56-23-5	Carbon Tetrachloride	ND	1.0	0.30	ND	0.16	0.048	
110-82-7	Cyclohexane	ND	2.0	0.52	ND	0.58	0.15	
78-87-5	1,2-Dichloropropane	ND	1.0	0.28	ND	0.22	0.061	
75-27-4	Bromodichloromethane	ND	1.0	0.30	ND	0.15	0.045	
79-01-6	Trichloroethene	ND	1.0	0.28	ND	0.19	0.052	
123-91-1	1,4-Dioxane	ND	1.0	0.28	ND	0.28	0.078	
80-62-6	Methyl Methacrylate	ND	2.0	0.52	ND	0.49	0.13	
142-82-5	n-Heptane	**1.7**	1.0	0.28	**0.41**	0.25	0.069	
10061-01-5	cis-1,3-Dichloropropene	ND	1.0	0.26	ND	0.22	0.058	
108-10-1	4-Methyl-2-pentanone	**1.1**	1.0	0.32	**0.27**	0.25	0.079	
10061-02-6	trans-1,3-Dichloropropene	ND	1.0	0.26	ND	0.22	0.058	
79-00-5	1,1,2-Trichloroethane	ND	1.0	0.26	ND	0.18	0.048	
108-88-3	Toluene	**12**	1.0	0.28	**3.2**	0.27	0.075	
591-78-6	2-Hexanone	**0.77**	1.0	0.38	**0.19**	0.25	0.093	J
124-48-1	Dibromochloromethane	ND	1.0	0.30	ND	0.12	0.035	
106-93-4	1,2-Dibromoethane	ND	1.0	0.30	ND	0.13	0.039	
123-86-4	n-Butyl Acetate	ND	1.0	0.36	ND	0.21	0.076	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062112-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-005

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00314

Date Collected: 6/21/12
Date Received: 7/2/12
Date Analyzed: 7/7/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -5.63 Final Pressure (psig): 3.56

Canister Dilution Factor: 2.01

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	**0.32**	1.0	0.28	**0.068**	0.22	0.060	J
127-18-4	Tetrachloroethene	ND	1.0	0.24	ND	0.15	0.036	
108-90-7	Chlorobenzene	ND	1.0	0.30	ND	0.22	0.065	
100-41-4	Ethylbenzene	**1.4**	1.0	0.30	**0.32**	0.23	0.069	
179601-23-1	m,p-Xylenes	**1.8**	2.0	0.58	**0.41**	0.46	0.13	J
75-25-2	Bromoform	ND	1.0	0.32	ND	0.097	0.031	
100-42-5	Styrene	**0.85**	1.0	0.30	**0.20**	0.24	0.071	J
95-47-6	o-Xylene	**0.64**	1.0	0.32	**0.15**	0.23	0.074	J
111-84-2	n-Nonane	**0.55**	1.0	0.28	**0.11**	0.19	0.054	J
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.0	0.30	ND	0.15	0.044	
98-82-8	Cumene	ND	1.0	0.28	ND	0.20	0.057	
80-56-8	alpha-Pinene	ND	1.0	0.28	ND	0.18	0.051	
103-65-1	n-Propylbenzene	ND	1.0	0.34	ND	0.20	0.070	
622-96-8	4-Ethyltoluene	ND	1.0	0.30	ND	0.20	0.061	
108-67-8	1,3,5-Trimethylbenzene	ND	1.0	0.30	ND	0.20	0.061	
95-63-6	1,2,4-Trimethylbenzene	**0.44**	1.0	0.30	**0.090**	0.20	0.061	J
100-44-7	Benzyl Chloride	ND	1.0	0.30	ND	0.19	0.058	
541-73-1	1,3-Dichlorobenzene	ND	1.0	0.28	ND	0.17	0.047	
106-46-7	1,4-Dichlorobenzene	ND	1.0	0.30	ND	0.17	0.050	
95-50-1	1,2-Dichlorobenzene	ND	1.0	0.32	ND	0.17	0.054	
5989-27-5	d-Limonene	**1.1**	1.0	0.34	**0.20**	0.18	0.061	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.0	0.28	ND	0.10	0.029	
120-82-1	1,2,4-Trichlorobenzene	ND	1.0	0.36	ND	0.14	0.049	
91-20-3	Naphthalene	ND	1.0	0.42	ND	0.19	0.081	
87-68-3	Hexachlorobutadiene	ND	1.0	0.28	ND	0.094	0.026	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062312-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-006

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00102

Date Collected: 6/23/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -9.01 Final Pressure (psig): 3.99

Canister Dilution Factor: 3.28

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**7.7**	1.6	0.43	**4.4**	0.95	0.25	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.7**	1.6	0.46	**0.54**	0.33	0.093	
74-87-3	Chloromethane	**0.87**	1.6	0.49	**0.42**	0.79	0.24	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.6	0.46	ND	0.23	0.066	
75-01-4	Vinyl Chloride	ND	1.6	0.49	ND	0.64	0.19	
106-99-0	1,3-Butadiene	**1.2**	1.6	0.52	**0.54**	0.74	0.24	J
74-83-9	Bromomethane	ND	1.6	0.46	ND	0.42	0.12	
75-00-3	Chloroethane	ND	1.6	0.46	ND	0.62	0.17	
64-17-5	Ethanol	ND	16	3.0	ND	8.7	1.6	
75-05-8	Acetonitrile	**21**	1.6	0.79	**12**	0.98	0.47	
107-02-8	Acrolein	ND	6.6	0.66	ND	2.9	0.29	
67-64-1	Acetone	**44**	16	3.6	**19**	6.9	1.5	
75-69-4	Trichlorofluoromethane	**1.3**	1.6	0.43	**0.24**	0.29	0.076	J
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	16	1.1	ND	6.7	0.45	L
107-13-1	Acrylonitrile	ND	1.6	0.59	ND	0.76	0.27	
75-35-4	1,1-Dichloroethene	ND	1.6	0.52	ND	0.41	0.13	
75-09-2	Methylene Chloride	**1.3**	1.6	0.49	**0.37**	0.47	0.14	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.6	0.46	ND	0.52	0.15	
76-13-1	Trichlorotrifluoroethane	ND	1.6	0.66	ND	0.21	0.086	
75-15-0	Carbon Disulfide	**0.69**	16	0.43	**0.22**	5.3	0.14	J
156-60-5	trans-1,2-Dichloroethene	**1.7**	1.6	0.49	**0.42**	0.41	0.12	
75-34-3	1,1-Dichloroethane	ND	1.6	0.46	ND	0.41	0.11	
1634-04-4	Methyl tert-Butyl Ether	ND	1.6	0.46	ND	0.46	0.13	
108-05-4	Vinyl Acetate	ND	16	2.0	ND	4.7	0.56	
78-93-3	2-Butanone (MEK)	ND	16	0.66	ND	5.6	0.22	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062312-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-006

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00102

Date Collected: 6/23/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -9.01 Final Pressure (psig): 3.99

Canister Dilution Factor: 3.28

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	1.6	0.52	ND	0.41	0.13	
141-78-6	Ethyl Acetate	ND	3.3	1.0	ND	0.91	0.29	
110-54-3	n-Hexane	**2.1**	1.6	0.52	**0.59**	0.47	0.15	
67-66-3	Chloroform	ND	1.6	0.46	ND	0.34	0.094	
109-99-9	Tetrahydrofuran (THF)	**1.9**	1.6	0.85	**0.66**	0.56	0.29	
107-06-2	1,2-Dichloroethane	ND	1.6	0.46	ND	0.41	0.11	
71-55-6	1,1,1-Trichloroethane	ND	1.6	0.46	ND	0.30	0.084	
71-43-2	Benzene	**31**	1.6	0.46	**9.9**	0.51	0.14	
56-23-5	Carbon Tetrachloride	ND	1.6	0.49	ND	0.26	0.078	
110-82-7	Cyclohexane	ND	3.3	0.85	ND	0.95	0.25	
78-87-5	1,2-Dichloropropane	ND	1.6	0.46	ND	0.35	0.099	
75-27-4	Bromodichloromethane	ND	1.6	0.49	ND	0.24	0.073	
79-01-6	Trichloroethene	ND	1.6	0.46	ND	0.31	0.085	
123-91-1	1,4-Dioxane	ND	1.6	0.46	ND	0.46	0.13	
80-62-6	Methyl Methacrylate	ND	3.3	0.85	ND	0.80	0.21	
142-82-5	n-Heptane	**0.81**	1.6	0.46	**0.20**	0.40	0.11	**J**
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	0.43	ND	0.36	0.094	
108-10-1	4-Methyl-2-pentanone	ND	1.6	0.52	ND	0.40	0.13	
10061-02-6	trans-1,3-Dichloropropene	ND	1.6	0.43	ND	0.36	0.094	
79-00-5	1,1,2-Trichloroethane	ND	1.6	0.43	ND	0.30	0.078	
108-88-3	Toluene	**13**	1.6	0.46	**3.4**	0.44	0.12	
591-78-6	2-Hexanone	ND	1.6	0.62	ND	0.40	0.15	
124-48-1	Dibromochloromethane	ND	1.6	0.49	ND	0.19	0.058	
106-93-4	1,2-Dibromoethane	ND	1.6	0.49	ND	0.21	0.064	
123-86-4	n-Butyl Acetate	ND	1.6	0.59	ND	0.35	0.12	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062312-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-006

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00102

Date Collected: 6/23/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -9.01 Final Pressure (psig): 3.99

Canister Dilution Factor: 3.28

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	1.6	0.46	ND	0.35	0.098	
127-18-4	Tetrachloroethene	ND	1.6	0.39	ND	0.24	0.058	
108-90-7	Chlorobenzene	ND	1.6	0.49	ND	0.36	0.11	
100-41-4	Ethylbenzene	**0.89**	1.6	0.49	**0.21**	0.38	0.11	**J**
179601-23-1	m,p-Xylenes	ND	3.3	0.95	ND	0.76	0.22	
75-25-2	Bromoform	ND	1.6	0.52	ND	0.16	0.051	
100-42-5	Styrene	ND	1.6	0.49	ND	0.39	0.12	
95-47-6	o-Xylene	ND	1.6	0.52	ND	0.38	0.12	
111-84-2	n-Nonane	ND	1.6	0.46	ND	0.31	0.088	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.6	0.49	ND	0.24	0.072	
98-82-8	Cumene	ND	1.6	0.46	ND	0.33	0.093	
80-56-8	alpha-Pinene	ND	1.6	0.46	ND	0.29	0.082	
103-65-1	n-Propylbenzene	ND	1.6	0.56	ND	0.33	0.11	
622-96-8	4-Ethyltoluene	ND	1.6	0.49	ND	0.33	0.10	
108-67-8	1,3,5-Trimethylbenzene	ND	1.6	0.49	ND	0.33	0.10	
95-63-6	1,2,4-Trimethylbenzene	ND	1.6	0.49	ND	0.33	0.10	
100-44-7	Benzyl Chloride	ND	1.6	0.49	ND	0.32	0.095	
541-73-1	1,3-Dichlorobenzene	ND	1.6	0.46	ND	0.27	0.076	
106-46-7	1,4-Dichlorobenzene	ND	1.6	0.49	ND	0.27	0.082	
95-50-1	1,2-Dichlorobenzene	ND	1.6	0.52	ND	0.27	0.087	
5989-27-5	d-Limonene	ND	1.6	0.56	ND	0.29	0.10	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.6	0.46	ND	0.17	0.048	
120-82-1	1,2,4-Trichlorobenzene	ND	1.6	0.59	ND	0.22	0.080	
91-20-3	Naphthalene	ND	1.6	0.69	ND	0.31	0.13	
87-68-3	Hexachlorobutadiene	ND	1.6	0.46	ND	0.15	0.043	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062512-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-007

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01605

Date Collected: 6/25/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -7.69 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.64

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**12**	1.3	0.34	**7.1**	0.77	0.20	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.5**	1.3	0.37	**0.50**	0.27	0.075	
74-87-3	Chloromethane	**0.68**	1.3	0.40	**0.33**	0.64	0.19	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.3	0.37	ND	0.19	0.053	
75-01-4	Vinyl Chloride	ND	1.3	0.40	ND	0.52	0.15	
106-99-0	1,3-Butadiene	**1.5**	1.3	0.42	**0.66**	0.60	0.19	
74-83-9	Bromomethane	ND	1.3	0.37	ND	0.34	0.095	
75-00-3	Chloroethane	ND	1.3	0.37	ND	0.50	0.14	
64-17-5	Ethanol	**3.0**	13	2.4	**1.6**	7.0	1.3	J
75-05-8	Acetonitrile	**77**	1.3	0.63	**46**	0.79	0.38	
107-02-8	Acrolein	**4.1**	5.3	0.53	**1.8**	2.3	0.23	J
67-64-1	Acetone	**51**	13	2.9	**21**	5.6	1.2	
75-69-4	Trichlorofluoromethane	**1.2**	1.3	0.34	**0.22**	0.23	0.061	J
67-63-0	2-Propanol (Isopropyl Alcohol)	**4.3**	13	0.90	**1.8**	5.4	0.37	J, L
107-13-1	Acrylonitrile	**1.9**	1.3	0.48	**0.88**	0.61	0.22	
75-35-4	1,1-Dichloroethene	ND	1.3	0.42	ND	0.33	0.11	
75-09-2	Methylene Chloride	**0.70**	1.3	0.40	**0.20**	0.38	0.11	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.3	0.37	ND	0.42	0.12	
76-13-1	Trichlorotrifluoroethane	**0.58**	1.3	0.53	**0.075**	0.17	0.069	J
75-15-0	Carbon Disulfide	**2.7**	13	0.34	**0.88**	4.2	0.11	J
156-60-5	trans-1,2-Dichloroethene	ND	1.3	0.40	ND	0.33	0.10	
75-34-3	1,1-Dichloroethane	ND	1.3	0.37	ND	0.33	0.091	
1634-04-4	Methyl tert-Butyl Ether	**0.79**	1.3	0.37	**0.22**	0.37	0.10	J
108-05-4	Vinyl Acetate	ND	13	1.6	ND	3.8	0.45	
78-93-3	2-Butanone (MEK)	**4.1**	13	0.53	**1.4**	4.5	0.18	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062512-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-007

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01605

Date Collected: 6/25/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -7.69 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.64

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	1.3	0.42	ND	0.33	0.11	
141-78-6	Ethyl Acetate	ND	2.6	0.84	ND	0.73	0.23	
110-54-3	n-Hexane	ND	1.3	0.42	ND	0.37	0.12	
67-66-3	Chloroform	ND	1.3	0.37	ND	0.27	0.076	
109-99-9	Tetrahydrofuran (THF)	ND	1.3	0.69	ND	0.45	0.23	
107-06-2	1,2-Dichloroethane	ND	1.3	0.37	ND	0.33	0.091	
71-55-6	1,1,1-Trichloroethane	ND	1.3	0.37	ND	0.24	0.068	
71-43-2	Benzene	**36**	1.3	0.37	**11**	0.41	0.12	
56-23-5	Carbon Tetrachloride	**0.44**	1.3	0.40	**0.070**	0.21	0.063	J
110-82-7	Cyclohexane	ND	2.6	0.69	ND	0.77	0.20	
78-87-5	1,2-Dichloropropane	ND	1.3	0.37	ND	0.29	0.080	
75-27-4	Bromodichloromethane	ND	1.3	0.40	ND	0.20	0.059	
79-01-6	Trichloroethene	ND	1.3	0.37	ND	0.25	0.069	
123-91-1	1,4-Dioxane	ND	1.3	0.37	ND	0.37	0.10	
80-62-6	Methyl Methacrylate	ND	2.6	0.69	ND	0.64	0.17	
142-82-5	n-Heptane	ND	1.3	0.37	ND	0.32	0.090	
10061-01-5	cis-1,3-Dichloropropene	ND	1.3	0.34	ND	0.29	0.076	
108-10-1	4-Methyl-2-pentanone	**1.4**	1.3	0.42	**0.35**	0.32	0.10	
10061-02-6	trans-1,3-Dichloropropene	ND	1.3	0.34	ND	0.29	0.076	
79-00-5	1,1,2-Trichloroethane	ND	1.3	0.34	ND	0.24	0.063	
108-88-3	Toluene	**14**	1.3	0.37	**3.8**	0.35	0.098	
591-78-6	2-Hexanone	**0.76**	1.3	0.50	**0.19**	0.32	0.12	J
124-48-1	Dibromochloromethane	ND	1.3	0.40	ND	0.16	0.047	
106-93-4	1,2-Dibromoethane	ND	1.3	0.40	ND	0.17	0.052	
123-86-4	n-Butyl Acetate	ND	1.3	0.48	ND	0.28	0.10	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062512-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-007

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01605

Date Collected: 6/25/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -7.69 Final Pressure (psig): 3.79

Canister Dilution Factor: 2.64

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	1.3	0.37	ND	0.28	0.079	
127-18-4	Tetrachloroethene	ND	1.3	0.32	ND	0.19	0.047	
108-90-7	Chlorobenzene	ND	1.3	0.40	ND	0.29	0.086	
100-41-4	Ethylbenzene	**4.5**	1.3	0.40	**1.0**	0.30	0.091	
179601-23-1	m,p-Xylenes	**0.93**	2.6	0.77	**0.22**	0.61	0.18	J
75-25-2	Bromoform	ND	1.3	0.42	ND	0.13	0.041	
100-42-5	Styrene	**16**	1.3	0.40	**3.8**	0.31	0.093	
95-47-6	o-Xylene	ND	1.3	0.42	ND	0.30	0.097	
111-84-2	n-Nonane	ND	1.3	0.37	ND	0.25	0.070	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.3	0.40	ND	0.19	0.058	
98-82-8	Cumene	ND	1.3	0.37	ND	0.27	0.075	
80-56-8	alpha-Pinene	ND	1.3	0.37	ND	0.24	0.066	
103-65-1	n-Propylbenzene	ND	1.3	0.45	ND	0.27	0.091	
622-96-8	4-Ethyltoluene	ND	1.3	0.40	ND	0.27	0.081	
108-67-8	1,3,5-Trimethylbenzene	ND	1.3	0.40	ND	0.27	0.081	
95-63-6	1,2,4-Trimethylbenzene	ND	1.3	0.40	ND	0.27	0.081	
100-44-7	Benzyl Chloride	ND	1.3	0.40	ND	0.26	0.077	
541-73-1	1,3-Dichlorobenzene	ND	1.3	0.37	ND	0.22	0.061	
106-46-7	1,4-Dichlorobenzene	ND	1.3	0.40	ND	0.22	0.066	
95-50-1	1,2-Dichlorobenzene	ND	1.3	0.42	ND	0.22	0.070	
5989-27-5	d-Limonene	**0.54**	1.3	0.45	**0.096**	0.24	0.081	J
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.3	0.37	ND	0.14	0.038	
120-82-1	1,2,4-Trichlorobenzene	ND	1.3	0.48	ND	0.18	0.064	
91-20-3	Naphthalene	ND	1.3	0.55	ND	0.25	0.11	
87-68-3	Hexachlorobutadiene	ND	1.3	0.37	ND	0.12	0.035	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-008

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00166

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.52 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.50

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**1.5**	0.75	0.20	**0.84**	0.44	0.11	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.3**	0.75	0.21	**0.47**	0.15	0.042	
74-87-3	Chloromethane	**0.66**	0.75	0.23	**0.32**	0.36	0.11	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.75	0.21	ND	0.11	0.030	
75-01-4	Vinyl Chloride	ND	0.75	0.23	ND	0.29	0.088	
106-99-0	1,3-Butadiene	ND	0.75	0.24	ND	0.34	0.11	
74-83-9	Bromomethane	ND	0.75	0.21	ND	0.19	0.054	
75-00-3	Chloroethane	ND	0.75	0.21	ND	0.28	0.080	
64-17-5	Ethanol	**2.0**	7.5	1.4	**1.1**	4.0	0.73	J
75-05-8	Acetonitrile	**0.82**	0.75	0.36	**0.49**	0.45	0.21	
107-02-8	Acrolein	**0.96**	3.0	0.30	**0.42**	1.3	0.13	J
67-64-1	Acetone	**22**	7.5	1.7	**9.1**	3.2	0.69	
75-69-4	Trichlorofluoromethane	**1.2**	0.75	0.20	**0.22**	0.13	0.035	
67-63-0	2-Propanol (Isopropyl Alcohol)	**1.6**	7.5	0.51	**0.65**	3.1	0.21	J, L
107-13-1	Acrylonitrile	ND	0.75	0.27	ND	0.35	0.12	
75-35-4	1,1-Dichloroethene	ND	0.75	0.24	ND	0.19	0.061	
75-09-2	Methylene Chloride	**0.76**	0.75	0.23	**0.22**	0.22	0.065	B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.75	0.21	ND	0.24	0.067	
76-13-1	Trichlorotrifluoroethane	**0.57**	0.75	0.30	**0.075**	0.098	0.039	J
75-15-0	Carbon Disulfide	**0.63**	7.5	0.20	**0.20**	2.4	0.063	J
156-60-5	trans-1,2-Dichloroethene	ND	0.75	0.23	ND	0.19	0.057	
75-34-3	1,1-Dichloroethane	ND	0.75	0.21	ND	0.19	0.052	
1634-04-4	Methyl tert-Butyl Ether	ND	0.75	0.21	ND	0.21	0.058	
108-05-4	Vinyl Acetate	ND	7.5	0.90	ND	2.1	0.26	
78-93-3	2-Butanone (MEK)	**6.0**	7.5	0.30	**2.1**	2.5	0.10	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-008

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00166

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.52 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.50

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.75	0.24	ND	0.19	0.061	
141-78-6	Ethyl Acetate	ND	1.5	0.48	ND	0.42	0.13	
110-54-3	n-Hexane	ND	0.75	0.24	ND	0.21	0.068	
67-66-3	Chloroform	**0.50**	0.75	0.21	**0.10**	0.15	0.043	J
109-99-9	Tetrahydrofuran (THF)	**2.4**	0.75	0.39	**0.83**	0.25	0.13	
107-06-2	1,2-Dichloroethane	ND	0.75	0.21	ND	0.19	0.052	
71-55-6	1,1,1-Trichloroethane	ND	0.75	0.21	ND	0.14	0.039	
71-43-2	Benzene	ND	0.75	0.21	ND	0.23	0.066	
56-23-5	Carbon Tetrachloride	**1.4**	0.75	0.23	**0.22**	0.12	0.036	
110-82-7	Cyclohexane	ND	1.5	0.39	ND	0.44	0.11	
78-87-5	1,2-Dichloropropane	ND	0.75	0.21	ND	0.16	0.045	
75-27-4	Bromodichloromethane	ND	0.75	0.23	ND	0.11	0.034	
79-01-6	Trichloroethene	ND	0.75	0.21	ND	0.14	0.039	
123-91-1	1,4-Dioxane	ND	0.75	0.21	ND	0.21	0.058	
80-62-6	Methyl Methacrylate	ND	1.5	0.39	ND	0.37	0.095	
142-82-5	n-Heptane	ND	0.75	0.21	ND	0.18	0.051	
10061-01-5	cis-1,3-Dichloropropene	ND	0.75	0.20	ND	0.17	0.043	
108-10-1	4-Methyl-2-pentanone	**3.8**	0.75	0.24	**0.92**	0.18	0.059	
10061-02-6	trans-1,3-Dichloropropene	ND	0.75	0.20	ND	0.17	0.043	
79-00-5	1,1,2-Trichloroethane	ND	0.75	0.20	ND	0.14	0.036	
108-88-3	Toluene	**0.31**	0.75	0.21	**0.082**	0.20	0.056	J
591-78-6	2-Hexanone	**1.2**	0.75	0.29	**0.29**	0.18	0.070	
124-48-1	Dibromochloromethane	ND	0.75	0.23	ND	0.088	0.026	
106-93-4	1,2-Dibromoethane	ND	0.75	0.23	ND	0.098	0.029	
123-86-4	n-Butyl Acetate	ND	0.75	0.27	ND	0.16	0.057	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-008

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00166

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.52 Final Pressure (psig): 3.56

Canister Dilution Factor: 1.50

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.75	0.21	ND	0.16	0.045	
127-18-4	Tetrachloroethene	ND	0.75	0.18	ND	0.11	0.027	
108-90-7	Chlorobenzene	ND	0.75	0.23	ND	0.16	0.049	
100-41-4	Ethylbenzene	ND	0.75	0.23	ND	0.17	0.052	
179601-23-1	m,p-Xylenes	ND	1.5	0.44	ND	0.35	0.10	
75-25-2	Bromoform	ND	0.75	0.24	ND	0.073	0.023	
100-42-5	Styrene	ND	0.75	0.23	ND	0.18	0.053	
95-47-6	o-Xylene	ND	0.75	0.24	ND	0.17	0.055	
111-84-2	n-Nonane	ND	0.75	0.21	ND	0.14	0.040	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.75	0.23	ND	0.11	0.033	
98-82-8	Cumene	ND	0.75	0.21	ND	0.15	0.043	
80-56-8	alpha-Pinene	ND	0.75	0.21	ND	0.13	0.038	
103-65-1	n-Propylbenzene	ND	0.75	0.26	ND	0.15	0.052	
622-96-8	4-Ethyltoluene	ND	0.75	0.23	ND	0.15	0.046	
108-67-8	1,3,5-Trimethylbenzene	ND	0.75	0.23	ND	0.15	0.046	
95-63-6	1,2,4-Trimethylbenzene	ND	0.75	0.23	ND	0.15	0.046	
100-44-7	Benzyl Chloride	ND	0.75	0.23	ND	0.14	0.043	
541-73-1	1,3-Dichlorobenzene	ND	0.75	0.21	ND	0.12	0.035	
106-46-7	1,4-Dichlorobenzene	ND	0.75	0.23	ND	0.12	0.037	
95-50-1	1,2-Dichlorobenzene	ND	0.75	0.24	ND	0.12	0.040	
5989-27-5	d-Limonene	ND	0.75	0.26	ND	0.13	0.046	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.75	0.21	ND	0.078	0.022	
120-82-1	1,2,4-Trichlorobenzene	ND	0.75	0.27	ND	0.10	0.036	
91-20-3	Naphthalene	ND	0.75	0.32	ND	0.14	0.060	
87-68-3	Hexachlorobutadiene	ND	0.75	0.21	ND	0.070	0.020	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-009

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00008

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -7.25 Final Pressure (psig): 3.78

Canister Dilution Factor: 2.48

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**2.8**	1.2	0.32	**1.6**	0.72	0.19	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	1.2	0.35	**0.52**	0.25	0.070	
74-87-3	Chloromethane	**0.69**	1.2	0.37	**0.33**	0.60	0.18	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.2	0.35	ND	0.18	0.050	
75-01-4	Vinyl Chloride	ND	1.2	0.37	ND	0.49	0.15	
106-99-0	1,3-Butadiene	ND	1.2	0.40	ND	0.56	0.18	
74-83-9	Bromomethane	ND	1.2	0.35	ND	0.32	0.089	
75-00-3	Chloroethane	ND	1.2	0.35	ND	0.47	0.13	
64-17-5	Ethanol	ND	12	2.3	ND	6.6	1.2	
75-05-8	Acetonitrile	ND	1.2	0.60	ND	0.74	0.35	
107-02-8	Acrolein	**0.76**	5.0	0.50	**0.33**	2.2	0.22	J
67-64-1	Acetone	**29**	12	2.7	**12**	5.2	1.1	
75-69-4	Trichlorofluoromethane	**1.4**	1.2	0.32	**0.24**	0.22	0.057	
67-63-0	2-Propanol (Isopropyl Alcohol)	**3.0**	12	0.84	**1.2**	5.0	0.34	J, L
107-13-1	Acrylonitrile	ND	1.2	0.45	ND	0.57	0.21	
75-35-4	1,1-Dichloroethene	ND	1.2	0.40	ND	0.31	0.10	
75-09-2	Methylene Chloride	**0.87**	1.2	0.37	**0.25**	0.36	0.11	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.2	0.35	ND	0.40	0.11	
76-13-1	Trichlorotrifluoroethane	**0.63**	1.2	0.50	**0.082**	0.16	0.065	J
75-15-0	Carbon Disulfide	**2.2**	12	0.32	**0.70**	4.0	0.10	J
156-60-5	trans-1,2-Dichloroethene	ND	1.2	0.37	ND	0.31	0.094	
75-34-3	1,1-Dichloroethane	ND	1.2	0.35	ND	0.31	0.086	
1634-04-4	Methyl tert-Butyl Ether	ND	1.2	0.35	ND	0.34	0.096	
108-05-4	Vinyl Acetate	ND	12	1.5	ND	3.5	0.42	
78-93-3	2-Butanone (MEK)	**2.7**	12	0.50	**0.92**	4.2	0.17	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-02** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P1202679-009

Test Code: EPA TO-15 Modified Date Collected: 6/27/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 7/2/12
Analyst: Wida Ang Date Analyzed: 7/9/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: SC00008

Initial Pressure (psig): -7.25 Final Pressure (psig): 3.78

Canister Dilution Factor: 2.48

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	1.2	0.40	ND	0.31	0.10	
141-78-6	Ethyl Acetate	ND	2.5	0.79	ND	0.69	0.22	
110-54-3	n-Hexane	ND	1.2	0.40	ND	0.35	0.11	
67-66-3	Chloroform	ND	1.2	0.35	ND	0.25	0.071	
109-99-9	Tetrahydrofuran (THF)	ND	1.2	0.64	ND	0.42	0.22	
107-06-2	1,2-Dichloroethane	ND	1.2	0.35	ND	0.31	0.086	
71-55-6	1,1,1-Trichloroethane	ND	1.2	0.35	ND	0.23	0.064	
71-43-2	Benzene	ND	1.2	0.35	ND	0.39	0.11	
56-23-5	Carbon Tetrachloride	**0.95**	1.2	0.37	**0.15**	0.20	0.059	J
110-82-7	Cyclohexane	ND	2.5	0.64	ND	0.72	0.19	
78-87-5	1,2-Dichloropropane	ND	1.2	0.35	ND	0.27	0.075	
75-27-4	Bromodichloromethane	ND	1.2	0.37	ND	0.19	0.056	
79-01-6	Trichloroethene	ND	1.2	0.35	ND	0.23	0.065	
123-91-1	1,4-Dioxane	ND	1.2	0.35	ND	0.34	0.096	
80-62-6	Methyl Methacrylate	ND	2.5	0.64	ND	0.61	0.16	
142-82-5	n-Heptane	ND	1.2	0.35	ND	0.30	0.085	
10061-01-5	cis-1,3-Dichloropropene	ND	1.2	0.32	ND	0.27	0.071	
108-10-1	4-Methyl-2-pentanone	**1.2**	1.2	0.40	**0.29**	0.30	0.097	J
10061-02-6	trans-1,3-Dichloropropene	ND	1.2	0.32	ND	0.27	0.071	
79-00-5	1,1,2-Trichloroethane	ND	1.2	0.32	ND	0.23	0.059	
108-88-3	Toluene	**0.37**	1.2	0.35	**0.099**	0.33	0.092	J
591-78-6	2-Hexanone	**0.72**	1.2	0.47	**0.18**	0.30	0.12	J
124-48-1	Dibromochloromethane	ND	1.2	0.37	ND	0.15	0.044	
106-93-4	1,2-Dibromoethane	ND	1.2	0.37	ND	0.16	0.048	
123-86-4	n-Butyl Acetate	ND	1.2	0.45	ND	0.26	0.094	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OB-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-009

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00008

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -7.25 Final Pressure (psig): 3.78

Canister Dilution Factor: 2.48

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	1.2	0.35	ND	0.27	0.074	
127-18-4	Tetrachloroethene	ND	1.2	0.30	ND	0.18	0.044	
108-90-7	Chlorobenzene	ND	1.2	0.37	ND	0.27	0.081	
100-41-4	Ethylbenzene	ND	1.2	0.37	ND	0.29	0.086	
179601-23-1	m,p-Xylenes	ND	2.5	0.72	ND	0.57	0.17	
75-25-2	Bromoform	ND	1.2	0.40	ND	0.12	0.038	
100-42-5	Styrene	ND	1.2	0.37	ND	0.29	0.087	
95-47-6	o-Xylene	ND	1.2	0.40	ND	0.29	0.091	
111-84-2	n-Nonane	ND	1.2	0.35	ND	0.24	0.066	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.2	0.37	ND	0.18	0.054	
98-82-8	Cumene	ND	1.2	0.35	ND	0.25	0.071	
80-56-8	alpha-Pinene	ND	1.2	0.35	ND	0.22	0.062	
103-65-1	n-Propylbenzene	ND	1.2	0.42	ND	0.25	0.086	
622-96-8	4-Ethyltoluene	ND	1.2	0.37	ND	0.25	0.076	
108-67-8	1,3,5-Trimethylbenzene	ND	1.2	0.37	ND	0.25	0.076	
95-63-6	1,2,4-Trimethylbenzene	ND	1.2	0.37	ND	0.25	0.076	
100-44-7	Benzyl Chloride	ND	1.2	0.37	ND	0.24	0.072	
541-73-1	1,3-Dichlorobenzene	ND	1.2	0.35	ND	0.21	0.058	
106-46-7	1,4-Dichlorobenzene	ND	1.2	0.37	ND	0.21	0.062	
95-50-1	1,2-Dichlorobenzene	ND	1.2	0.40	ND	0.21	0.066	
5989-27-5	d-Limonene	ND	1.2	0.42	ND	0.22	0.076	
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.2	0.35	ND	0.13	0.036	
120-82-1	1,2,4-Trichlorobenzene	ND	1.2	0.45	ND	0.17	0.060	
91-20-3	Naphthalene	ND	1.2	0.52	ND	0.24	0.099	
87-68-3	Hexachlorobutadiene	ND	1.2	0.35	ND	0.12	0.033	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-010

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01595

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -8.81 Final Pressure (psig): 3.83

Canister Dilution Factor: 3.15

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**10**	1.6	0.41	**5.9**	0.92	0.24	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.9**	1.6	0.44	**0.58**	0.32	0.089	
74-87-3	Chloromethane	**0.68**	1.6	0.47	**0.33**	0.76	0.23	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	1.6	0.44	ND	0.23	0.063	
75-01-4	Vinyl Chloride	ND	1.6	0.47	ND	0.62	0.18	
106-99-0	1,3-Butadiene	**1.3**	1.6	0.50	**0.58**	0.71	0.23	J
74-83-9	Bromomethane	ND	1.6	0.44	ND	0.41	0.11	
75-00-3	Chloroethane	ND	1.6	0.44	ND	0.60	0.17	
64-17-5	Ethanol	**14**	16	2.9	**7.4**	8.4	1.5	J
75-05-8	Acetonitrile	**80**	1.6	0.76	**48**	0.94	0.45	
107-02-8	Acrolein	ND	6.3	0.63	ND	2.7	0.27	
67-64-1	Acetone	**13**	16	3.5	**5.4**	6.6	1.5	J
75-69-4	Trichlorofluoromethane	**1.3**	1.6	0.41	**0.24**	0.28	0.073	J
67-63-0	2-Propanol (Isopropyl Alcohol)	**3.5**	16	1.1	**1.4**	6.4	0.44	J
107-13-1	Acrylonitrile	**1.8**	1.6	0.57	**0.82**	0.73	0.26	
75-35-4	1,1-Dichloroethene	ND	1.6	0.50	ND	0.40	0.13	
75-09-2	Methylene Chloride	**1.2**	1.6	0.47	**0.34**	0.45	0.14	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	1.6	0.44	ND	0.50	0.14	
76-13-1	Trichlorotrifluoroethane	**0.64**	1.6	0.63	**0.083**	0.21	0.082	J
75-15-0	Carbon Disulfide	**0.64**	16	0.41	**0.20**	5.1	0.13	J
156-60-5	trans-1,2-Dichloroethene	**0.84**	1.6	0.47	**0.21**	0.40	0.12	J
75-34-3	1,1-Dichloroethane	ND	1.6	0.44	ND	0.39	0.11	
1634-04-4	Methyl tert-Butyl Ether	ND	1.6	0.44	ND	0.44	0.12	
108-05-4	Vinyl Acetate	ND	16	1.9	ND	4.5	0.54	
78-93-3	2-Butanone (MEK)	**8.6**	16	0.63	**2.9**	5.3	0.21	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-01** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P1202679-010

Test Code: EPA TO-15 Modified Date Collected: 6/27/12
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: 7/2/12
Analyst: Wida Ang Date Analyzed: 7/6/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:
Container ID: SC01595

Initial Pressure (psig): -8.81 Final Pressure (psig): 3.83

Canister Dilution Factor: 3.15

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	1.6	0.50	ND	0.40	0.13	
141-78-6	Ethyl Acetate	ND	3.2	1.0	ND	0.87	0.28	
110-54-3	n-Hexane	**0.80**	1.6	0.50	**0.23**	0.45	0.14	J
67-66-3	Chloroform	ND	1.6	0.44	ND	0.32	0.090	
109-99-9	Tetrahydrofuran (THF)	**4.0**	1.6	0.82	**1.3**	0.53	0.28	
107-06-2	1,2-Dichloroethane	ND	1.6	0.44	ND	0.39	0.11	
71-55-6	1,1,1-Trichloroethane	ND	1.6	0.44	ND	0.29	0.081	
71-43-2	Benzene	**45**	1.6	0.44	**14**	0.49	0.14	
56-23-5	Carbon Tetrachloride	ND	1.6	0.47	ND	0.25	0.075	
110-82-7	Cyclohexane	ND	3.2	0.82	ND	0.92	0.24	
78-87-5	1,2-Dichloropropane	ND	1.6	0.44	ND	0.34	0.095	
75-27-4	Bromodichloromethane	ND	1.6	0.47	ND	0.24	0.071	
79-01-6	Trichloroethene	ND	1.6	0.44	ND	0.29	0.082	
123-91-1	1,4-Dioxane	ND	1.6	0.44	ND	0.44	0.12	
80-62-6	Methyl Methacrylate	ND	3.2	0.82	ND	0.77	0.20	
142-82-5	n-Heptane	**1.0**	1.6	0.44	**0.25**	0.38	0.11	J
10061-01-5	cis-1,3-Dichloropropene	ND	1.6	0.41	ND	0.35	0.090	
108-10-1	4-Methyl-2-pentanone	**1.1**	1.6	0.50	**0.28**	0.38	0.12	J
10061-02-6	trans-1,3-Dichloropropene	ND	1.6	0.41	ND	0.35	0.090	
79-00-5	1,1,2-Trichloroethane	ND	1.6	0.41	ND	0.29	0.075	
108-88-3	Toluene	**21**	1.6	0.44	**5.5**	0.42	0.12	
591-78-6	2-Hexanone	**0.95**	1.6	0.60	**0.23**	0.38	0.15	J
124-48-1	Dibromochloromethane	ND	1.6	0.47	ND	0.18	0.055	
106-93-4	1,2-Dibromoethane	ND	1.6	0.47	ND	0.21	0.062	
123-86-4	n-Butyl Acetate	ND	1.6	0.57	ND	0.33	0.12	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-01**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-010

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01595

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -8.81 Final Pressure (psig): 3.83

Canister Dilution Factor: 3.15

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	1.6	0.44	ND	0.34	0.094	
127-18-4	Tetrachloroethene	ND	1.6	0.38	ND	0.23	0.056	
108-90-7	Chlorobenzene	ND	1.6	0.47	ND	0.34	0.10	
100-41-4	Ethylbenzene	**4.4**	1.6	0.47	**1.0**	0.36	0.11	
179601-23-1	m,p-Xylenes	**1.4**	3.2	0.91	**0.31**	0.73	0.21	J
75-25-2	Bromoform	ND	1.6	0.50	ND	0.15	0.049	
100-42-5	Styrene	**13**	1.6	0.47	**3.1**	0.37	0.11	
95-47-6	o-Xylene	**0.52**	1.6	0.50	**0.12**	0.36	0.12	J
111-84-2	n-Nonane	ND	1.6	0.44	ND	0.30	0.084	
79-34-5	1,1,2,2-Tetrachloroethane	ND	1.6	0.47	ND	0.23	0.069	
98-82-8	Cumene	ND	1.6	0.44	ND	0.32	0.090	
80-56-8	alpha-Pinene	ND	1.6	0.44	ND	0.28	0.079	
103-65-1	n-Propylbenzene	ND	1.6	0.54	ND	0.32	0.11	
622-96-8	4-Ethyltoluene	ND	1.6	0.47	ND	0.32	0.096	
108-67-8	1,3,5-Trimethylbenzene	ND	1.6	0.47	ND	0.32	0.096	
95-63-6	1,2,4-Trimethylbenzene	ND	1.6	0.47	ND	0.32	0.096	
100-44-7	Benzyl Chloride	ND	1.6	0.47	ND	0.30	0.091	
541-73-1	1,3-Dichlorobenzene	ND	1.6	0.44	ND	0.26	0.073	
106-46-7	1,4-Dichlorobenzene	ND	1.6	0.47	ND	0.26	0.079	
95-50-1	1,2-Dichlorobenzene	ND	1.6	0.50	ND	0.26	0.084	
5989-27-5	d-Limonene	**1.3**	1.6	0.54	**0.24**	0.28	0.096	J
96-12-8	1,2-Dibromo-3-chloropropane	ND	1.6	0.44	ND	0.16	0.046	
120-82-1	1,2,4-Trichlorobenzene	ND	1.6	0.57	ND	0.21	0.076	
91-20-3	Naphthalene	ND	1.6	0.66	ND	0.30	0.13	
87-68-3	Hexachlorobutadiene	ND	1.6	0.44	ND	0.15	0.041	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-011

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00109

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.51 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.63

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**1.2**	0.82	0.21	**0.70**	0.47	0.12	
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.7**	0.82	0.23	**0.55**	0.16	0.046	
74-87-3	Chloromethane	**0.58**	0.82	0.24	**0.28**	0.39	0.12	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.82	0.23	ND	0.12	0.033	
75-01-4	Vinyl Chloride	ND	0.82	0.24	ND	0.32	0.096	
106-99-0	1,3-Butadiene	ND	0.82	0.26	ND	0.37	0.12	
74-83-9	Bromomethane	ND	0.82	0.23	ND	0.21	0.059	
75-00-3	Chloroethane	ND	0.82	0.23	ND	0.31	0.087	
64-17-5	Ethanol	ND	8.2	1.5	ND	4.3	0.80	
75-05-8	Acetonitrile	**3.1**	0.82	0.39	**1.8**	0.49	0.23	
107-02-8	Acrolein	ND	3.3	0.33	ND	1.4	0.14	
67-64-1	Acetone	**16**	8.2	1.8	**6.6**	3.4	0.76	
75-69-4	Trichlorofluoromethane	**1.3**	0.82	0.21	**0.23**	0.15	0.038	
67-63-0	2-Propanol (Isopropyl Alcohol)	**1.0**	8.2	0.55	**0.42**	3.3	0.23	J
107-13-1	Acrylonitrile	**0.75**	0.82	0.29	**0.34**	0.38	0.14	J
75-35-4	1,1-Dichloroethene	ND	0.82	0.26	ND	0.21	0.066	
75-09-2	Methylene Chloride	**0.51**	0.82	0.24	**0.15**	0.23	0.070	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.82	0.23	ND	0.26	0.073	
76-13-1	Trichlorotrifluoroethane	**0.60**	0.82	0.33	**0.079**	0.11	0.043	J
75-15-0	Carbon Disulfide	**0.99**	8.2	0.21	**0.32**	2.6	0.068	J
156-60-5	trans-1,2-Dichloroethene	ND	0.82	0.24	ND	0.21	0.062	
75-34-3	1,1-Dichloroethane	ND	0.82	0.23	ND	0.20	0.056	
1634-04-4	Methyl tert-Butyl Ether	ND	0.82	0.23	ND	0.23	0.063	
108-05-4	Vinyl Acetate	ND	8.2	0.98	ND	2.3	0.28	
78-93-3	2-Butanone (MEK)	**1.5**	8.2	0.33	**0.50**	2.8	0.11	J

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-011

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00109

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.51 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.63

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.82	0.26	ND	0.21	0.066	
141-78-6	Ethyl Acetate	ND	1.6	0.52	ND	0.45	0.14	
110-54-3	n-Hexane	ND	0.82	0.26	ND	0.23	0.074	
67-66-3	Chloroform	ND	0.82	0.23	ND	0.17	0.047	
109-99-9	Tetrahydrofuran (THF)	ND	0.82	0.42	ND	0.28	0.14	
107-06-2	1,2-Dichloroethane	ND	0.82	0.23	ND	0.20	0.056	
71-55-6	1,1,1-Trichloroethane	ND	0.82	0.23	ND	0.15	0.042	
71-43-2	Benzene	**0.86**	0.82	0.23	**0.27**	0.26	0.071	
56-23-5	Carbon Tetrachloride	ND	0.82	0.24	ND	0.13	0.039	
110-82-7	Cyclohexane	ND	1.6	0.42	ND	0.47	0.12	
78-87-5	1,2-Dichloropropane	ND	0.82	0.23	ND	0.18	0.049	
75-27-4	Bromodichloromethane	ND	0.82	0.24	ND	0.12	0.037	
79-01-6	Trichloroethene	ND	0.82	0.23	ND	0.15	0.042	
123-91-1	1,4-Dioxane	ND	0.82	0.23	ND	0.23	0.063	
80-62-6	Methyl Methacrylate	ND	1.6	0.42	ND	0.40	0.10	
142-82-5	n-Heptane	ND	0.82	0.23	ND	0.20	0.056	
10061-01-5	cis-1,3-Dichloropropene	ND	0.82	0.21	ND	0.18	0.047	
108-10-1	4-Methyl-2-pentanone	**0.35**	0.82	0.26	**0.086**	0.20	0.064	J
10061-02-6	trans-1,3-Dichloropropene	ND	0.82	0.21	ND	0.18	0.047	
79-00-5	1,1,2-Trichloroethane	ND	0.82	0.21	ND	0.15	0.039	
108-88-3	Toluene	**0.36**	0.82	0.23	**0.096**	0.22	0.061	J
591-78-6	2-Hexanone	ND	0.82	0.31	ND	0.20	0.076	
124-48-1	Dibromochloromethane	ND	0.82	0.24	ND	0.096	0.029	
106-93-4	1,2-Dibromoethane	ND	0.82	0.24	ND	0.11	0.032	
123-86-4	n-Butyl Acetate	ND	0.82	0.29	ND	0.17	0.062	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **PS-OD-SC-062712-02**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-011

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00109

Date Collected: 6/27/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -3.51 Final Pressure (psig): 3.54

Canister Dilution Factor: 1.63

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.82	0.23	ND	0.17	0.049	
127-18-4	Tetrachloroethene	ND	0.82	0.20	ND	0.12	0.029	
108-90-7	Chlorobenzene	ND	0.82	0.24	ND	0.18	0.053	
100-41-4	Ethylbenzene	ND	0.82	0.24	ND	0.19	0.056	
179601-23-1	m,p-Xylenes	ND	1.6	0.47	ND	0.38	0.11	
75-25-2	Bromoform	ND	0.82	0.26	ND	0.079	0.025	
100-42-5	Styrene	ND	0.82	0.24	ND	0.19	0.057	
95-47-6	o-Xylene	ND	0.82	0.26	ND	0.19	0.060	
111-84-2	n-Nonane	ND	0.82	0.23	ND	0.16	0.044	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.82	0.24	ND	0.12	0.036	
98-82-8	Cumene	ND	0.82	0.23	ND	0.17	0.046	
80-56-8	alpha-Pinene	ND	0.82	0.23	ND	0.15	0.041	
103-65-1	n-Propylbenzene	ND	0.82	0.28	ND	0.17	0.056	
622-96-8	4-Ethyltoluene	ND	0.82	0.24	ND	0.17	0.050	
108-67-8	1,3,5-Trimethylbenzene	ND	0.82	0.24	ND	0.17	0.050	
95-63-6	1,2,4-Trimethylbenzene	ND	0.82	0.24	ND	0.17	0.050	
100-44-7	Benzyl Chloride	ND	0.82	0.24	ND	0.16	0.047	
541-73-1	1,3-Dichlorobenzene	ND	0.82	0.23	ND	0.14	0.038	
106-46-7	1,4-Dichlorobenzene	ND	0.82	0.24	ND	0.14	0.041	
95-50-1	1,2-Dichlorobenzene	ND	0.82	0.26	ND	0.14	0.043	
5989-27-5	d-Limonene	ND	0.82	0.28	ND	0.15	0.050	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.82	0.23	ND	0.084	0.024	
120-82-1	1,2,4-Trichlorobenzene	ND	0.82	0.29	ND	0.11	0.040	
91-20-3	Naphthalene	ND	0.82	0.34	ND	0.16	0.065	
87-68-3	Hexachlorobutadiene	ND	0.82	0.23	ND	0.076	0.021	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-SC-062812**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-012

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01577

Date Collected: 6/28/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.66 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.51

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	**0.59**	0.76	0.20	**0.34**	0.44	0.11	J
75-71-8	Dichlorodifluoromethane (CFC 12)	**2.6**	0.76	0.21	**0.53**	0.15	0.043	
74-87-3	Chloromethane	**0.55**	0.76	0.23	**0.27**	0.37	0.11	J
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.76	0.21	ND	0.11	0.030	
75-01-4	Vinyl Chloride	ND	0.76	0.23	ND	0.30	0.089	
106-99-0	1,3-Butadiene	ND	0.76	0.24	ND	0.34	0.11	
74-83-9	Bromomethane	ND	0.76	0.21	ND	0.19	0.054	
75-00-3	Chloroethane	ND	0.76	0.21	ND	0.29	0.080	
64-17-5	Ethanol	**2.7**	7.6	1.4	**1.5**	4.0	0.74	J
75-05-8	Acetonitrile	ND	0.76	0.36	ND	0.45	0.22	
107-02-8	Acrolein	**0.54**	3.0	0.30	**0.24**	1.3	0.13	J
67-64-1	Acetone	**11**	7.6	1.7	**4.8**	3.2	0.70	
75-69-4	Trichlorofluoromethane	**1.3**	0.76	0.20	**0.22**	0.13	0.035	
67-63-0	2-Propanol (Isopropyl Alcohol)	**1.0**	7.6	0.51	**0.40**	3.1	0.21	J
107-13-1	Acrylonitrile	ND	0.76	0.27	ND	0.35	0.13	
75-35-4	1,1-Dichloroethene	ND	0.76	0.24	ND	0.19	0.061	
75-09-2	Methylene Chloride	**0.44**	0.76	0.23	**0.13**	0.22	0.065	J, B
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.76	0.21	ND	0.24	0.068	
76-13-1	Trichlorotrifluoroethane	**0.58**	0.76	0.30	**0.075**	0.099	0.039	J
75-15-0	Carbon Disulfide	**0.25**	7.6	0.20	**0.080**	2.4	0.063	J
156-60-5	trans-1,2-Dichloroethene	ND	0.76	0.23	ND	0.19	0.057	
75-34-3	1,1-Dichloroethane	ND	0.76	0.21	ND	0.19	0.052	
1634-04-4	Methyl tert-Butyl Ether	ND	0.76	0.21	ND	0.21	0.059	
108-05-4	Vinyl Acetate	ND	7.6	0.91	ND	2.1	0.26	
78-93-3	2-Butanone (MEK)	ND	7.6	0.30	ND	2.6	0.10	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
B = Analyte detected in both the sample and associated method blank.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-SC-062812**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-012

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01577

Date Collected: 6/28/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.66 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.51

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.76	0.24	ND	0.19	0.061	
141-78-6	Ethyl Acetate	ND	1.5	0.48	ND	0.42	0.13	
110-54-3	n-Hexane	ND	0.76	0.24	ND	0.21	0.069	
67-66-3	Chloroform	ND	0.76	0.21	ND	0.15	0.043	
109-99-9	Tetrahydrofuran (THF)	**1.3**	0.76	0.39	**0.43**	0.26	0.13	
107-06-2	1,2-Dichloroethane	ND	0.76	0.21	ND	0.19	0.052	
71-55-6	1,1,1-Trichloroethane	ND	0.76	0.21	ND	0.14	0.039	
71-43-2	Benzene	ND	0.76	0.21	ND	0.24	0.066	
56-23-5	Carbon Tetrachloride	**0.24**	0.76	0.23	**0.039**	0.12	0.036	J
110-82-7	Cyclohexane	ND	1.5	0.39	ND	0.44	0.11	
78-87-5	1,2-Dichloropropane	ND	0.76	0.21	ND	0.16	0.046	
75-27-4	Bromodichloromethane	ND	0.76	0.23	ND	0.11	0.034	
79-01-6	Trichloroethene	ND	0.76	0.21	ND	0.14	0.039	
123-91-1	1,4-Dioxane	ND	0.76	0.21	ND	0.21	0.059	
80-62-6	Methyl Methacrylate	ND	1.5	0.39	ND	0.37	0.096	
142-82-5	n-Heptane	ND	0.76	0.21	ND	0.18	0.052	
10061-01-5	cis-1,3-Dichloropropene	ND	0.76	0.20	ND	0.17	0.043	
108-10-1	4-Methyl-2-pentanone	**0.44**	0.76	0.24	**0.11**	0.18	0.059	J
10061-02-6	trans-1,3-Dichloropropene	ND	0.76	0.20	ND	0.17	0.043	
79-00-5	1,1,2-Trichloroethane	ND	0.76	0.20	ND	0.14	0.036	
108-88-3	Toluene	**0.22**	0.76	0.21	**0.058**	0.20	0.056	J
591-78-6	2-Hexanone	ND	0.76	0.29	ND	0.18	0.070	
124-48-1	Dibromochloromethane	ND	0.76	0.23	ND	0.089	0.027	
106-93-4	1,2-Dibromoethane	ND	0.76	0.23	ND	0.098	0.029	
123-86-4	n-Butyl Acetate	ND	0.76	0.27	ND	0.16	0.057	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **BS-OD-SC-062812**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P1202679-012

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01577

Date Collected: 6/28/12
Date Received: 7/2/12
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Initial Pressure (psig): -2.66 Final Pressure (psig): 3.50

Canister Dilution Factor: 1.51

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.76	0.21	ND	0.16	0.045	
127-18-4	Tetrachloroethene	ND	0.76	0.18	ND	0.11	0.027	
108-90-7	Chlorobenzene	ND	0.76	0.23	ND	0.16	0.049	
100-41-4	Ethylbenzene	ND	0.76	0.23	ND	0.17	0.052	
179601-23-1	m,p-Xylenes	ND	1.5	0.44	ND	0.35	0.10	
75-25-2	Bromoform	ND	0.76	0.24	ND	0.073	0.023	
100-42-5	Styrene	ND	0.76	0.23	ND	0.18	0.053	
95-47-6	o-Xylene	ND	0.76	0.24	ND	0.17	0.056	
111-84-2	n-Nonane	ND	0.76	0.21	ND	0.14	0.040	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.76	0.23	ND	0.11	0.033	
98-82-8	Cumene	ND	0.76	0.21	ND	0.15	0.043	
80-56-8	alpha-Pinene	ND	0.76	0.21	ND	0.14	0.038	
103-65-1	n-Propylbenzene	ND	0.76	0.26	ND	0.15	0.052	
622-96-8	4-Ethyltoluene	ND	0.76	0.23	ND	0.15	0.046	
108-67-8	1,3,5-Trimethylbenzene	ND	0.76	0.23	ND	0.15	0.046	
95-63-6	1,2,4-Trimethylbenzene	ND	0.76	0.23	ND	0.15	0.046	
100-44-7	Benzyl Chloride	ND	0.76	0.23	ND	0.15	0.044	
541-73-1	1,3-Dichlorobenzene	ND	0.76	0.21	ND	0.13	0.035	
106-46-7	1,4-Dichlorobenzene	ND	0.76	0.23	ND	0.13	0.038	
95-50-1	1,2-Dichlorobenzene	ND	0.76	0.24	ND	0.13	0.040	
5989-27-5	d-Limonene	ND	0.76	0.26	ND	0.14	0.046	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.76	0.21	ND	0.078	0.022	
120-82-1	1,2,4-Trichlorobenzene	ND	0.76	0.27	ND	0.10	0.037	
91-20-3	Naphthalene	ND	0.76	0.32	ND	0.14	0.061	
87-68-3	Hexachlorobutadiene	ND	0.76	0.21	ND	0.071	0.020	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-MB

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	ND	0.50	0.13	ND	0.29	0.076	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	0.50	0.14	ND	0.10	0.028	
74-87-3	Chloromethane	ND	0.50	0.15	ND	0.24	0.073	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.50	0.14	ND	0.072	0.020	
75-01-4	Vinyl Chloride	ND	0.50	0.15	ND	0.20	0.059	
106-99-0	1,3-Butadiene	ND	0.50	0.16	ND	0.23	0.072	
74-83-9	Bromomethane	ND	0.50	0.14	ND	0.13	0.036	
75-00-3	Chloroethane	ND	0.50	0.14	ND	0.19	0.053	
64-17-5	Ethanol	ND	5.0	0.92	ND	2.7	0.49	
75-05-8	Acetonitrile	ND	0.50	0.24	ND	0.30	0.14	
107-02-8	Acrolein	ND	2.0	0.20	ND	0.87	0.087	
67-64-1	Acetone	ND	5.0	1.1	ND	2.1	0.46	
75-69-4	Trichlorofluoromethane	ND	0.50	0.13	ND	0.089	0.023	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	5.0	0.34	ND	2.0	0.14	
107-13-1	Acrylonitrile	ND	0.50	0.18	ND	0.23	0.083	
75-35-4	1,1-Dichloroethene	ND	0.50	0.16	ND	0.13	0.040	
75-09-2	Methylene Chloride	**0.19**	0.50	0.15	**0.056**	0.14	0.043	**J**
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.50	0.14	ND	0.16	0.045	
76-13-1	Trichlorotrifluoroethane	ND	0.50	0.20	ND	0.065	0.026	
75-15-0	Carbon Disulfide	ND	5.0	0.13	ND	1.6	0.042	
156-60-5	trans-1,2-Dichloroethene	ND	0.50	0.15	ND	0.13	0.038	
75-34-3	1,1-Dichloroethane	ND	0.50	0.14	ND	0.12	0.035	
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	0.14	ND	0.14	0.039	
108-05-4	Vinyl Acetate	ND	5.0	0.60	ND	1.4	0.17	
78-93-3	2-Butanone (MEK)	ND	5.0	0.20	ND	1.7	0.068	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-MB

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.50	0.16	ND	0.13	0.040	
141-78-6	Ethyl Acetate	ND	1.0	0.32	ND	0.28	0.089	
110-54-3	n-Hexane	ND	0.50	0.16	ND	0.14	0.045	
67-66-3	Chloroform	ND	0.50	0.14	ND	0.10	0.029	
109-99-9	Tetrahydrofuran (THF)	ND	0.50	0.26	ND	0.17	0.088	
107-06-2	1,2-Dichloroethane	ND	0.50	0.14	ND	0.12	0.035	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.14	ND	0.092	0.026	
71-43-2	Benzene	ND	0.50	0.14	ND	0.16	0.044	
56-23-5	Carbon Tetrachloride	ND	0.50	0.15	ND	0.080	0.024	
110-82-7	Cyclohexane	ND	1.0	0.26	ND	0.29	0.076	
78-87-5	1,2-Dichloropropane	ND	0.50	0.14	ND	0.11	0.030	
75-27-4	Bromodichloromethane	ND	0.50	0.15	ND	0.075	0.022	
79-01-6	Trichloroethene	ND	0.50	0.14	ND	0.093	0.026	
123-91-1	1,4-Dioxane	ND	0.50	0.14	ND	0.14	0.039	
80-62-6	Methyl Methacrylate	ND	1.0	0.26	ND	0.24	0.064	
142-82-5	n-Heptane	ND	0.50	0.14	ND	0.12	0.034	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.13	ND	0.11	0.029	
108-10-1	4-Methyl-2-pentanone	ND	0.50	0.16	ND	0.12	0.039	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.13	ND	0.11	0.029	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.13	ND	0.092	0.024	
108-88-3	Toluene	ND	0.50	0.14	ND	0.13	0.037	
591-78-6	2-Hexanone	ND	0.50	0.19	ND	0.12	0.046	
124-48-1	Dibromochloromethane	ND	0.50	0.15	ND	0.059	0.018	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ND	0.065	0.020	
123-86-4	n-Butyl Acetate	ND	0.50	0.18	ND	0.11	0.038	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-MB

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/6/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.50	0.14	ND	0.11	0.030	
127-18-4	Tetrachloroethene	ND	0.50	0.12	ND	0.074	0.018	
108-90-7	Chlorobenzene	ND	0.50	0.15	ND	0.11	0.033	
100-41-4	Ethylbenzene	ND	0.50	0.15	ND	0.12	0.035	
179601-23-1	m,p-Xylenes	ND	1.0	0.29	ND	0.23	0.067	
75-25-2	Bromoform	ND	0.50	0.16	ND	0.048	0.015	
100-42-5	Styrene	ND	0.50	0.15	ND	0.12	0.035	
95-47-6	o-Xylene	ND	0.50	0.16	ND	0.12	0.037	
111-84-2	n-Nonane	ND	0.50	0.14	ND	0.095	0.027	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.15	ND	0.073	0.022	
98-82-8	Cumene	ND	0.50	0.14	ND	0.10	0.028	
80-56-8	alpha-Pinene	ND	0.50	0.14	ND	0.090	0.025	
103-65-1	n-Propylbenzene	ND	0.50	0.17	ND	0.10	0.035	
622-96-8	4-Ethyltoluene	ND	0.50	0.15	ND	0.10	0.031	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.15	ND	0.10	0.031	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.15	ND	0.10	0.031	
100-44-7	Benzyl Chloride	ND	0.50	0.15	ND	0.097	0.029	
541-73-1	1,3-Dichlorobenzene	ND	0.50	0.14	ND	0.083	0.023	
106-46-7	1,4-Dichlorobenzene	ND	0.50	0.15	ND	0.083	0.025	
95-50-1	1,2-Dichlorobenzene	ND	0.50	0.16	ND	0.083	0.027	
5989-27-5	d-Limonene	ND	0.50	0.17	ND	0.090	0.031	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.50	0.14	ND	0.052	0.014	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.18	ND	0.067	0.024	
91-20-3	Naphthalene	ND	0.50	0.21	ND	0.095	0.040	
87-68-3	Hexachlorobutadiene	ND	0.50	0.14	ND	0.047	0.013	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120709-MB

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
115-07-1	Propene	ND	0.50	0.13	ND	0.29	0.076	
75-71-8	Dichlorodifluoromethane (CFC 12)	ND	0.50	0.14	ND	0.10	0.028	
74-87-3	Chloromethane	ND	0.50	0.15	ND	0.24	0.073	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	0.50	0.14	ND	0.072	0.020	
75-01-4	Vinyl Chloride	ND	0.50	0.15	ND	0.20	0.059	
106-99-0	1,3-Butadiene	ND	0.50	0.16	ND	0.23	0.072	
74-83-9	Bromomethane	ND	0.50	0.14	ND	0.13	0.036	
75-00-3	Chloroethane	ND	0.50	0.14	ND	0.19	0.053	
64-17-5	Ethanol	ND	5.0	0.92	ND	2.7	0.49	
75-05-8	Acetonitrile	ND	0.50	0.24	ND	0.30	0.14	
107-02-8	Acrolein	ND	2.0	0.20	ND	0.87	0.087	
67-64-1	Acetone	ND	5.0	1.1	ND	2.1	0.46	
75-69-4	Trichlorofluoromethane	ND	0.50	0.13	ND	0.089	0.023	
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	5.0	0.34	ND	2.0	0.14	L
107-13-1	Acrylonitrile	ND	0.50	0.18	ND	0.23	0.083	
75-35-4	1,1-Dichloroethene	ND	0.50	0.16	ND	0.13	0.040	
75-09-2	Methylene Chloride	**0.21**	0.50	0.15	**0.061**	0.14	0.043	J
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	0.50	0.14	ND	0.16	0.045	
76-13-1	Trichlorotrifluoroethane	ND	0.50	0.20	ND	0.065	0.026	
75-15-0	Carbon Disulfide	ND	5.0	0.13	ND	1.6	0.042	
156-60-5	trans-1,2-Dichloroethene	ND	0.50	0.15	ND	0.13	0.038	
75-34-3	1,1-Dichloroethane	ND	0.50	0.14	ND	0.12	0.035	
1634-04-4	Methyl tert-Butyl Ether	ND	0.50	0.14	ND	0.14	0.039	
108-05-4	Vinyl Acetate	ND	5.0	0.60	ND	1.4	0.17	
78-93-3	2-Butanone (MEK)	ND	5.0	0.20	ND	1.7	0.068	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
J = The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank** CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** CAS Sample ID: P120709-MB

Test Code: EPA TO-15 Modified Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date Received: NA
Analyst: Wida Ang Date Analyzed: 7/9/12
Sampling Media: 6.0 L Summa Canister Volume(s) Analyzed: 1.00 Liter(s)
Test Notes:

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	ND	0.50	0.16	ND	0.13	0.040	
141-78-6	Ethyl Acetate	ND	1.0	0.32	ND	0.28	0.089	
110-54-3	n-Hexane	ND	0.50	0.16	ND	0.14	0.045	
67-66-3	Chloroform	ND	0.50	0.14	ND	0.10	0.029	
109-99-9	Tetrahydrofuran (THF)	ND	0.50	0.26	ND	0.17	0.088	
107-06-2	1,2-Dichloroethane	ND	0.50	0.14	ND	0.12	0.035	
71-55-6	1,1,1-Trichloroethane	ND	0.50	0.14	ND	0.092	0.026	
71-43-2	Benzene	ND	0.50	0.14	ND	0.16	0.044	
56-23-5	Carbon Tetrachloride	ND	0.50	0.15	ND	0.080	0.024	
110-82-7	Cyclohexane	ND	1.0	0.26	ND	0.29	0.076	
78-87-5	1,2-Dichloropropane	ND	0.50	0.14	ND	0.11	0.030	
75-27-4	Bromodichloromethane	ND	0.50	0.15	ND	0.075	0.022	
79-01-6	Trichloroethene	ND	0.50	0.14	ND	0.093	0.026	
123-91-1	1,4-Dioxane	ND	0.50	0.14	ND	0.14	0.039	
80-62-6	Methyl Methacrylate	ND	1.0	0.26	ND	0.24	0.064	
142-82-5	n-Heptane	ND	0.50	0.14	ND	0.12	0.034	
10061-01-5	cis-1,3-Dichloropropene	ND	0.50	0.13	ND	0.11	0.029	
108-10-1	4-Methyl-2-pentanone	ND	0.50	0.16	ND	0.12	0.039	
10061-02-6	trans-1,3-Dichloropropene	ND	0.50	0.13	ND	0.11	0.029	
79-00-5	1,1,2-Trichloroethane	ND	0.50	0.13	ND	0.092	0.024	
108-88-3	Toluene	ND	0.50	0.14	ND	0.13	0.037	
591-78-6	2-Hexanone	ND	0.50	0.19	ND	0.12	0.046	
124-48-1	Dibromochloromethane	ND	0.50	0.15	ND	0.059	0.018	
106-93-4	1,2-Dibromoethane	ND	0.50	0.15	ND	0.065	0.020	
123-86-4	n-Butyl Acetate	ND	0.50	0.18	ND	0.11	0.038	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Method Blank**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120709-MB

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/9/12
Volume(s) Analyzed: 1.00 Liter(s)

Canister Dilution Factor: 1.00

CAS #	Compound	Result µg/m³	MRL µg/m³	MDL µg/m³	Result ppbV	MRL ppbV	MDL ppbV	Data Qualifier
111-65-9	n-Octane	ND	0.50	0.14	ND	0.11	0.030	
127-18-4	Tetrachloroethene	ND	0.50	0.12	ND	0.074	0.018	
108-90-7	Chlorobenzene	ND	0.50	0.15	ND	0.11	0.033	
100-41-4	Ethylbenzene	ND	0.50	0.15	ND	0.12	0.035	
179601-23-1	m,p-Xylenes	ND	1.0	0.29	ND	0.23	0.067	
75-25-2	Bromoform	ND	0.50	0.16	ND	0.048	0.015	
100-42-5	Styrene	ND	0.50	0.15	ND	0.12	0.035	
95-47-6	o-Xylene	ND	0.50	0.16	ND	0.12	0.037	
111-84-2	n-Nonane	ND	0.50	0.14	ND	0.095	0.027	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.50	0.15	ND	0.073	0.022	
98-82-8	Cumene	ND	0.50	0.14	ND	0.10	0.028	
80-56-8	alpha-Pinene	ND	0.50	0.14	ND	0.090	0.025	
103-65-1	n-Propylbenzene	ND	0.50	0.17	ND	0.10	0.035	
622-96-8	4-Ethyltoluene	ND	0.50	0.15	ND	0.10	0.031	
108-67-8	1,3,5-Trimethylbenzene	ND	0.50	0.15	ND	0.10	0.031	
95-63-6	1,2,4-Trimethylbenzene	ND	0.50	0.15	ND	0.10	0.031	
100-44-7	Benzyl Chloride	ND	0.50	0.15	ND	0.097	0.029	
541-73-1	1,3-Dichlorobenzene	ND	0.50	0.14	ND	0.083	0.023	
106-46-7	1,4-Dichlorobenzene	ND	0.50	0.15	ND	0.083	0.025	
95-50-1	1,2-Dichlorobenzene	ND	0.50	0.16	ND	0.083	0.027	
5989-27-5	d-Limonene	ND	0.50	0.17	ND	0.090	0.031	
96-12-8	1,2-Dibromo-3-chloropropane	ND	0.50	0.14	ND	0.052	0.014	
120-82-1	1,2,4-Trichlorobenzene	ND	0.50	0.18	ND	0.067	0.024	
91-20-3	Naphthalene	ND	0.50	0.21	ND	0.095	0.040	
87-68-3	Hexachlorobutadiene	ND	0.50	0.14	ND	0.047	0.013	

ND = Compound was analyzed for, but not detected above the laboratory detection limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

SURROGATE SPIKE RECOVERY RESULTS

Client: **ARCADIS U.S., Inc.**
Client Project ID: **Air Testing Tooele / 31670** CAS Project ID: P1202679

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 Date(s) Collected: 6/14 - 6/28/12
Analyst: Wida Ang Date(s) Received: 7/2/12
Sampling Media: 6.0 L Summa Canister(s) Date(s) Analyzed: 7/6 - 7/9/12
Test Notes:

Client Sample ID	CAS Sample ID	1,2-Dichloroethane-d4 Percent Recovered	Toluene-d8 Percent Recovered	Bromofluorobenzene Percent Recovered	Acceptance Limits	Data Qualifier
Method Blank	P120706-MB	**109**	**99**	**109**	70-130	
Method Blank	P120709-MB	**110**	**99**	**108**	70-130	
Lab Control Sample	P120706-LCS	**113**	**99**	**114**	70-130	
Lab Control Sample	P120709-LCS	**110**	**98**	**113**	70-130	
BS-OD-061412	P1202679-001	**110**	**97**	**111**	70-130	
PS-OD-061612	P1202679-002	**112**	**98**	**111**	70-130	
BS-OD-062012	P1202679-003	**113**	**94**	**111**	70-130	
PS-OD-SC-062112-01	P1202679-004	**113**	**98**	**112**	70-130	
PS-OD-SC-062112-02	P1202679-005	**110**	**95**	**115**	70-130	
PS-OD-SC-062312-01	P1202679-006	**114**	**96**	**112**	70-130	
PS-OD-SC-062512-01	P1202679-007	**111**	**100**	**112**	70-130	
PS-OB-SC-062712-01	P1202679-008	**107**	**96**	**113**	70-130	
PS-OB-SC-062712-02	P1202679-009	**113**	**95**	**113**	70-130	
PS-OD-SC-062712-01	P1202679-010	**113**	**96**	**108**	70-130	
PS-OD-SC-062712-02	P1202679-011	**113**	**96**	**110**	70-130	
BS-OD-SC-062812	P1202679-012	**112**	**98**	**111**	70-130	

Surrogate percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly from the on-column percent recovery.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample** — CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** — CAS Sample ID: P120706-LCS

Test Code: EPA TO-15 Modified — Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 — Date Received: NA
Analyst: Wida Ang — Date Analyzed: 7/06/12
Sampling Media: 6.0 L Summa Canister — Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
115-07-1	Propene	198	**218**	**110**	59-137	
75-71-8	Dichlorodifluoromethane (CFC 12)	196	**218**	**111**	63-115	
74-87-3	Chloromethane	190	**220**	**116**	59-124	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	200	**201**	**101**	65-113	
75-01-4	Vinyl Chloride	194	**208**	**107**	59-121	
106-99-0	1,3-Butadiene	204	**213**	**104**	60-138	
74-83-9	Bromomethane	194	**196**	**101**	69-129	
75-00-3	Chloroethane	196	**199**	**102**	60-120	
64-17-5	Ethanol	928	**951**	**102**	58-121	
75-05-8	Acetonitrile	194	**221**	**114**	64-129	
107-02-8	Acrolein	198	**196**	**99**	54-127	
67-64-1	Acetone	1,010	**1030**	**102**	59-114	
75-69-4	Trichlorofluoromethane	202	**200**	**99**	66-108	
67-63-0	2-Propanol (Isopropyl Alcohol)	382	**472**	**124**	50-113	L
107-13-1	Acrylonitrile	198	**240**	**121**	72-135	
75-35-4	1,1-Dichloroethene	212	**210**	**99**	70-117	
75-09-2	Methylene Chloride	206	**207**	**100**	61-108	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	208	**215**	**103**	70-131	
76-13-1	Trichlorotrifluoroethane	206	**210**	**102**	70-113	
75-15-0	Carbon Disulfide	208	**205**	**99**	65-112	
156-60-5	trans-1,2-Dichloroethene	196	**210**	**107**	71-119	
75-34-3	1,1-Dichloroethane	200	**205**	**103**	71-116	
1634-04-4	Methyl tert-Butyl Ether	198	**210**	**106**	67-116	
108-05-4	Vinyl Acetate	952	**1090**	**114**	59-142	
78-93-3	2-Butanone (MEK)	206	**235**	**114**	68-125	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample**
Client Project ID: **Air Testing Tooele / 31670**

CAS Project ID: P1202679
CAS Sample ID: P120706-LCS

Test Code: EPA TO-15 Modified
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9
Analyst: Wida Ang
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 7/06/12
Volume(s) Analyzed: 0.125 Liter(s)

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	206	**207**	**100**	69-119	
141-78-6	Ethyl Acetate	398	**451**	**113**	63-130	
110-54-3	n-Hexane	198	**205**	**104**	57-120	
67-66-3	Chloroform	214	**209**	**98**	69-111	
109-99-9	Tetrahydrofuran (THF)	202	**212**	**105**	57-123	
107-06-2	1,2-Dichloroethane	200	**214**	**107**	70-118	
71-55-6	1,1,1-Trichloroethane	198	**193**	**97**	73-119	
71-43-2	Benzene	198	**169**	**85**	66-121	
56-23-5	Carbon Tetrachloride	202	**204**	**101**	74-129	
110-82-7	Cyclohexane	390	**382**	**98**	70-113	
78-87-5	1,2-Dichloropropane	198	**193**	**97**	69-118	
75-27-4	Bromodichloromethane	198	**198**	**100**	75-124	
79-01-6	Trichloroethene	194	**188**	**97**	73-115	
123-91-1	1,4-Dioxane	200	**194**	**97**	71-123	
80-62-6	Methyl Methacrylate	400	**425**	**106**	72-127	
142-82-5	n-Heptane	196	**188**	**96**	68-120	
10061-01-5	cis-1,3-Dichloropropene	188	**199**	**106**	71-130	
108-10-1	4-Methyl-2-pentanone	204	**207**	**101**	69-130	
10061-02-6	trans-1,3-Dichloropropene	210	**226**	**108**	76-133	
79-00-5	1,1,2-Trichloroethane	196	**180**	**92**	73-120	
108-88-3	Toluene	202	**183**	**91**	67-111	
591-78-6	2-Hexanone	222	**220**	**99**	70-123	
124-48-1	Dibromochloromethane	206	**200**	**97**	75-129	
106-93-4	1,2-Dibromoethane	200	**190**	**95**	73-122	
123-86-4	n-Butyl Acetate	220	**223**	**101**	68-132	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample** — CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** — CAS Sample ID: P120706-LCS

Test Code: EPA TO-15 Modified — Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 — Date Received: NA
Analyst: Wida Ang — Date Analyzed: 7/06/12
Sampling Media: 6.0 L Summa Canister — Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
111-65-9	n-Octane	200	**196**	**98**	68-116	
127-18-4	Tetrachloroethene	184	**168**	**91**	67-119	
108-90-7	Chlorobenzene	202	**181**	**90**	69-113	
100-41-4	Ethylbenzene	198	**185**	**93**	71-117	
179601-23-1	m,p-Xylenes	392	**374**	**95**	70-116	
75-25-2	Bromoform	208	**200**	**96**	69-127	
100-42-5	Styrene	200	**202**	**101**	71-125	
95-47-6	o-Xylene	194	**188**	**97**	70-116	
111-84-2	n-Nonane	196	**190**	**97**	68-116	
79-34-5	1,1,2,2-Tetrachloroethane	192	**174**	**91**	70-119	
98-82-8	Cumene	190	**180**	**95**	70-116	
80-56-8	alpha-Pinene	186	**184**	**99**	71-119	
103-65-1	n-Propylbenzene	192	**188**	**98**	71-119	
622-96-8	4-Ethyltoluene	198	**193**	**97**	71-119	
108-67-8	1,3,5-Trimethylbenzene	200	**200**	**100**	71-121	
95-63-6	1,2,4-Trimethylbenzene	194	**207**	**107**	73-127	
100-44-7	Benzyl Chloride	200	**216**	**108**	65-137	
541-73-1	1,3-Dichlorobenzene	200	**189**	**95**	68-123	
106-46-7	1,4-Dichlorobenzene	206	**190**	**92**	65-120	
95-50-1	1,2-Dichlorobenzene	198	**187**	**94**	67-121	
5989-27-5	d-Limonene	200	**223**	**112**	67-130	
96-12-8	1,2-Dibromo-3-chloropropane	196	**192**	**98**	72-133	
120-82-1	1,2,4-Trichlorobenzene	196	**176**	**90**	62-133	
91-20-3	Naphthalene	172	**167**	**97**	56-138	
87-68-3	Hexachlorobutadiene	202	**178**	**88**	60-128	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample** — CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** — CAS Sample ID: P120709-LCS

Test Code: EPA TO-15 Modified — Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 — Date Received: NA
Analyst: Wida Ang — Date Analyzed: 7/09/12
Sampling Media: 6.0 L Summa Canister — Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
115-07-1	Propene	198	**223**	**113**	59-137	
75-71-8	Dichlorodifluoromethane (CFC 12)	196	**219**	**112**	63-115	
74-87-3	Chloromethane	190	**235**	**124**	59-124	
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	200	**221**	**111**	65-113	
75-01-4	Vinyl Chloride	194	**232**	**120**	59-121	
106-99-0	1,3-Butadiene	204	**223**	**109**	60-138	
74-83-9	Bromomethane	194	**208**	**107**	69-129	
75-00-3	Chloroethane	196	**206**	**105**	60-120	
64-17-5	Ethanol	928	**994**	**107**	58-121	
75-05-8	Acetonitrile	194	**233**	**120**	64-129	
107-02-8	Acrolein	198	**200**	**101**	54-127	
67-64-1	Acetone	1,010	**1040**	**103**	59-114	
75-69-4	Trichlorofluoromethane	202	**209**	**103**	66-108	
67-63-0	2-Propanol (Isopropyl Alcohol)	382	**509**	**133**	50-113	L
107-13-1	Acrylonitrile	198	**258**	**130**	72-135	
75-35-4	1,1-Dichloroethene	212	**228**	**108**	70-117	
75-09-2	Methylene Chloride	206	**218**	**106**	61-108	
107-05-1	3-Chloro-1-propene (Allyl Chloride)	208	**216**	**104**	70-131	
76-13-1	Trichlorotrifluoroethane	206	**228**	**111**	70-113	
75-15-0	Carbon Disulfide	208	**217**	**104**	65-112	
156-60-5	trans-1,2-Dichloroethene	196	**218**	**111**	71-119	
75-34-3	1,1-Dichloroethane	200	**217**	**109**	71-116	
1634-04-4	Methyl tert-Butyl Ether	198	**220**	**111**	67-116	
108-05-4	Vinyl Acetate	952	**1140**	**120**	59-142	
78-93-3	2-Butanone (MEK)	206	**245**	**119**	68-125	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.
L = Laboratory control sample recovery outside the specified limits, results may be biased high.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample** — CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** — CAS Sample ID: P120709-LCS

Test Code: EPA TO-15 Modified — Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 — Date Received: NA
Analyst: Wida Ang — Date Analyzed: 7/09/12
Sampling Media: 6.0 L Summa Canister — Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
156-59-2	cis-1,2-Dichloroethene	206	**225**	**109**	69-119	
141-78-6	Ethyl Acetate	398	**474**	**119**	63-130	
110-54-3	n-Hexane	198	**216**	**109**	57-120	
67-66-3	Chloroform	214	**225**	**105**	69-111	
109-99-9	Tetrahydrofuran (THF)	202	**229**	**113**	57-123	
107-06-2	1,2-Dichloroethane	200	**226**	**113**	70-118	
71-55-6	1,1,1-Trichloroethane	198	**215**	**109**	73-119	
71-43-2	Benzene	198	**189**	**95**	66-121	
56-23-5	Carbon Tetrachloride	202	**227**	**112**	74-129	
110-82-7	Cyclohexane	390	**413**	**106**	70-113	
78-87-5	1,2-Dichloropropane	198	**205**	**104**	69-118	
75-27-4	Bromodichloromethane	198	**212**	**107**	75-124	
79-01-6	Trichloroethene	194	**207**	**107**	73-115	
123-91-1	1,4-Dioxane	200	**218**	**109**	71-123	
80-62-6	Methyl Methacrylate	400	**471**	**118**	72-127	
142-82-5	n-Heptane	196	**210**	**107**	68-120	
10061-01-5	cis-1,3-Dichloropropene	188	**214**	**114**	71-130	
108-10-1	4-Methyl-2-pentanone	204	**231**	**113**	69-130	
10061-02-6	trans-1,3-Dichloropropene	210	**254**	**121**	76-133	
79-00-5	1,1,2-Trichloroethane	196	**204**	**104**	73-120	
108-88-3	Toluene	202	**196**	**97**	67-111	
591-78-6	2-Hexanone	222	**230**	**104**	70-123	
124-48-1	Dibromochloromethane	206	**221**	**107**	75-129	
106-93-4	1,2-Dibromoethane	200	**211**	**106**	73-122	
123-86-4	n-Butyl Acetate	220	**240**	**109**	68-132	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

LABORATORY CONTROL SAMPLE SUMMARY

Client: **ARCADIS U.S., Inc.**
Client Sample ID: **Lab Control Sample** — CAS Project ID: P1202679
Client Project ID: **Air Testing Tooele / 31670** — CAS Sample ID: P120709-LCS

Test Code: EPA TO-15 Modified — Date Collected: NA
Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9 — Date Received: NA
Analyst: Wida Ang — Date Analyzed: 7/09/12
Sampling Media: 6.0 L Summa Canister — Volume(s) Analyzed: 0.125 Liter(s)
Test Notes:

CAS #	Compound	Spike Amount µg/m³	Result µg/m³	% Recovery	CAS Acceptance Limits	Data Qualifier
111-65-9	n-Octane	200	**204**	**102**	68-116	
127-18-4	Tetrachloroethene	184	**181**	**98**	67-119	
108-90-7	Chlorobenzene	202	**200**	**99**	69-113	
100-41-4	Ethylbenzene	198	**201**	**102**	71-117	
179601-23-1	m,p-Xylenes	392	**401**	**102**	70-116	
75-25-2	Bromoform	208	**213**	**102**	69-127	
100-42-5	Styrene	200	**217**	**109**	71-125	
95-47-6	o-Xylene	194	**200**	**103**	70-116	
111-84-2	n-Nonane	196	**200**	**102**	68-116	
79-34-5	1,1,2,2-Tetrachloroethane	192	**180**	**94**	70-119	
98-82-8	Cumene	190	**191**	**101**	70-116	
80-56-8	alpha-Pinene	186	**196**	**105**	71-119	
103-65-1	n-Propylbenzene	192	**197**	**103**	71-119	
622-96-8	4-Ethyltoluene	198	**201**	**102**	71-119	
108-67-8	1,3,5-Trimethylbenzene	200	**210**	**105**	71-121	
95-63-6	1,2,4-Trimethylbenzene	194	**218**	**112**	73-127	
100-44-7	Benzyl Chloride	200	**220**	**110**	65-137	
541-73-1	1,3-Dichlorobenzene	200	**201**	**101**	68-123	
106-46-7	1,4-Dichlorobenzene	206	**200**	**97**	65-120	
95-50-1	1,2-Dichlorobenzene	198	**197**	**99**	67-121	
5989-27-5	d-Limonene	200	**231**	**116**	67-130	
96-12-8	1,2-Dibromo-3-chloropropane	196	**206**	**105**	72-133	
120-82-1	1,2,4-Trichlorobenzene	196	**195**	**99**	62-133	
91-20-3	Naphthalene	172	**180**	**105**	56-138	
87-68-3	Hexachlorobutadiene	202	**196**	**97**	60-128	

Laboratory Control Sample percent recovery is verified and accepted based on the on-column result.
Reported results are shown in concentration units and as a result of the calculation, may vary slightly.

Response Factor Report GC 01

Method : J:\GC01\METHODS\M032512.M (Chemstation Integrator)
Title : EPA 25C TCA/FID Analysis for TGNMO
Last Update : Sat Apr 07 12:26:51 2012

Calibration Files
0.6 =03251202.D 5 =03251210.D 13 =03251205.D
100 =03251206.D 500 =03251207.D 5000 =03251208.D

	Compound	0.6	5	13	100	500	5000	Avg	%RSD
1)	Carbon Monoxide		4.919	4.493	5.067	5.654	5.474	5.121 E3	8.98
2)	Methane	6.399	6.030	4.975	5.213	5.805	5.641	5.677 E3	9.23
3)	Carbon Dioxide		6.919	5.158	5.290	5.941	5.589	5.780 E3	12.19
4)	TGNMO-1	3.711	5.159	4.579	4.994	5.452	5.341	4.873 E3	13.26
5)	TGMNO-2	3.710	5.160	4.579	4.994	5.452	5.341	4.873 E3	13.26

(#) = Out of Range
M032512.M Sat Apr 07 16:00:15 2012 Page 1

Modified EPA Method 25C Daily QC Summary

Client : ARCADIS U.S., Inc.
Analyst : WHH
Method Name : EPA 25C TCA/FID Analysis for TGNMO

Service Request # : P1202679
Instrument : 7/7/2012
Date Analyzed : 7/7/2012

RT Summaries and QC Check (minutes)

Sample ID	Carbon Monoxide	Methane	Carbon Dioxide	TGNMO-1	TGMNO-2		File ID	Time
ICAL Mean RT	**1.474**	**1.953**	**3.224**	**5.243**				
RT Windows (+/- min)	**0.330**	**0.330**	**0.330**	**0.330**				
std s27-02081201	1.578	2.083	3.385	5.271			07071201.D	10:22
+/- 0.33min of ICAL Mean RT	Pass	Pass	Pass	Pass				
mb			3.383 Pass	N/A	N/A		07071203.D	11:47
lab air		2.080 Pass	3.377 Pass	N/A	N/A		07071204.D	12:05
lcs s27-02081202	1.569 Pass	2.073 Pass	3.375 Pass	N/A	N/A		07071205.D	12:33
lcsd s27-02081202	1.570 Pass	2.075 Pass	3.378 Pass	N/A	N/A		07071206.D	12:44
2679-007	1.558 Pass	2.063 Pass	3.379 Pass	N/A	N/A		07071207.D	13:01
2679-008			3.387 Pass	N/A	N/A		07071208.D	13:22
2679-009			3.382 Pass	N/A	N/A		07071209.D	13:42
2679-010	1.567 Pass		3.384 Pass	N/A	N/A		07071210.D	14:10
2679-011			3.389 Pass	N/A	N/A		07071211.D	14:27
2679-012			3.380 Pass	N/A	N/A		07071212.D	14:45
std s27-02081201	1.579 Pass	2.086 Pass	3.386 Pass	N/A	N/A		07071214.D	15:24

vv = Vent CO_2 / CH_4 v = Vent CO_2 N/A : Not Applicable

Continuing Calibration Standards Summary (ppm)

Sample ID	Carbon Monoxide	Methane	Carbon Dioxide			TGMNO	File ID	Time
ACTUAL	99.7	79.8	99.7			99.3		
CCV Criteria (+/- %D)	**15.0%**	**15.0%**	**15.0%**			**15.0%**		
std s27-02081201	98.0 Pass	72.9 Pass	91.5 Pass			91.6 Pass	07071201.D	10:22
std s27-02081201	105.5 Pass	78.3 Pass	98.8 Pass			96.5 Pass	07071214.D	15:24

LCS / LCS Dup Summary (ppm, without DF correction)

Sample ID	Carbon Monoxide	Methane	Carbon Dioxide			TGMNO	File ID	Time
LCS Actual Conc. (ppm)	99.8	80.0	99.8			98.8		
LCS Criteria (% Range)	**73%-132%**	**75%-132%**	**71%-123%**			**71%-136%**		
lcs s27-02081202	100.2	73.1	92.2			103.2	07071205.D	12:33
LCS % Recovery	100%	91%	92%			104%		
	Pass	Pass	Pass			Pass		
lcsd s27-02081202	102.2	74.5	94.1			105.4	07071206.D	12:44
LCS % Recovery	102%	93%	94%			107%		
	Pass	Pass	Pass			Pass		
Duplicate % RPD	2.0%	1.9%	2.0%			2.1%		
Duplicate Criteria % RPD	**15%**	**14%**	**15%**			**14%**		
	Pass	Pass	Pass			Pass		

Lab Dup Summary (ppm, without DF correction)

Sample ID	Carbon Monoxide	Methane	Carbon Dioxide			TGMNO	File ID	Time

Response Factor Report MS09

Method Path : J:\MS09\Methods\
Method File : R9053012.M
Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
Last Update : Wed May 30 07:42:16 2012
Response Via : Initial Calibration

Calibration Files
0.1 =05301202.D 0.2 =05301203.D 0.5 =05301204.D 1.0 =05301205.D 5.0 =05301206.D 25 =05301207.D
50 =05301208.D 100 =05301209.D

		Compound	0.1	0.2	0.5	1.0	5.0	25	50	100	Avg	%RSD
1)	IR	Bromochloromethane...	----------ISTD----------									
2)	T	Propene	1.473	1.107	0.909	0.915	1.296	1.538	1.328	1.165	1.216	19.36
3)	T	Dichlorodifluo...	3.156	2.656	2.359	2.463	2.511	2.714	2.409	2.265	2.567	10.92
4)	T	Chloromethane	2.196	1.939	1.511	1.645	1.399	1.729	1.521	1.206	1.643	19.02
5)	T	1,2-Dichloro-1...	1.863	1.686	1.264	1.466	1.484	1.544	1.412	1.369	1.511	12.48
6)	T	Vinyl Chloride	1.992	1.950	1.612	1.716	1.772	1.886	1.738	1.682	1.794	7.52
7)	T	1,3-Butadiene	1.405	1.130	1.010	1.173	1.200	1.364	1.231	1.202	1.214	10.33
8)	T	Bromomethane	1.672	1.437	1.121	1.198	1.185	1.321	1.221	1.203	1.295	13.96
9)	T	Chloroethane	1.090	0.912	0.776	0.767	0.800	0.913	0.847	0.840	0.868	12.14
10)	T	Ethanol	1.098	0.861	0.603	0.688	0.715	0.817	0.752	0.740	0.784	18.97
11)	T	Acetonitrile		1.836	1.345	1.579	1.543	1.708	1.577	1.507	1.585	9.77
12)	T	Acrolein	0.706	0.695	0.469	0.538	0.557	0.653	0.597	0.566	0.598	13.73
13)	T	Acetone			0.712	0.765	0.739	0.831	0.757	0.722	0.754	5.68
14)	T	Trichlorofluor...	2.992	2.494	1.815	2.119	2.084	2.361	2.159	2.149	2.272	15.52
15)	T	2-Propanol (Is...			2.006	2.291	1.653	1.733	1.412	1.421	1.753	19.61
16)	T	Acrylonitrile		0.813	1.011	1.149	1.197	1.373	1.318	1.261	1.160	16.68
17)	T	1,1-Dichloroet...	1.656	1.329	0.988	1.118	1.119	1.256	1.144	1.167	1.222	16.55
18)	T	2-Methyl-2-Pro...	2.955	2.531	2.087	2.326	2.386	2.477	1.329		2.299	21.83
19)	T	Methylene Chlo...			1.423	1.272	1.193	1.300	1.190	1.151	1.255	7.91
20)	T	3-Chloro-1-pro...	1.642	1.320	1.030	1.201	1.271	1.473	1.356	1.295	1.323	13.69
21)	T	Trichlorotrifl...	1.317	1.133	0.992	1.089	1.081	1.193	1.100	1.102	1.126	8.47
22)	T	Carbon Disulfide	5.799	4.897	3.694	4.004	4.164	4.718	4.297	4.389	4.495	14.45
23)	T	trans-1,2-Dich...	1.853	1.640	1.373	1.541	1.510	1.734	1.605	1.534	1.599	9.18
24)	T	1,1-Dichloroet...	2.443	2.071	1.697	1.806	1.878	2.145	1.954	1.891	1.986	11.72
25)	T	Methyl tert-Bu...	4.100	3.842	2.821	3.117	3.209	3.727	3.438	3.250	3.438	12.33
26)	T	Vinyl Acetate	0.196	0.185	0.174	0.206	0.246	0.293	0.283	0.281	0.233	20.81
27)	T	2-Butanone (MEK)	0.656	0.726	0.434	0.625	0.702	0.801	0.740	0.704	0.674	16.38
28)	T	cis-1,2-Dichlo...	1.971	1.695	1.242	1.387	1.441	1.626	1.533	1.472	1.546	14.33
29)	T	Diisopropyl Ether	1.306	1.012	0.830	0.888	0.921	1.054	1.002	0.986	1.000	14.37
30)	T	Ethyl Acetate		0.332	0.289	0.388	0.392	0.454	0.417	0.417	0.384	14.61
31)	T	n-Hexane	2.267	1.829	1.624	1.759	1.757	2.070	1.874	1.783	1.870	10.94

Method Path : J:\MS09\Methods\
Method File : R9053012.M
Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)

32)	T	Chloroform	2.503	2.138	1.806	1.932	1.897	2.072	1.949	1.969	2.033	10.59
33)	S	1,2-Dichloroet...	1.206	1.171	1.173	1.182	1.169	1.169	1.119	1.163	1.169	2.08
34)	T	Tetrahydrofura...	0.956	0.665	0.636	0.659	0.689	0.767	0.719	0.706	0.725	14.06
35)	T	Ethyl tert-But...	1.584	1.587	1.114	1.319	1.333	1.523	1.458	1.429	1.418	11.26
36)	T	1,2-Dichloroet...	1.877	1.589	1.284	1.445	1.390	1.542	1.416	1.429	1.497	12.00
37)	IR	1,4-Difluorobenzen...	----------ISTD----------									
38)	T	1,1,1-Trichlor...	0.549	0.470	0.391	0.446	0.429	0.486	0.472	0.444	0.461	10.03
39)	T	Isopropyl Acetate	0.177	0.139	0.128	0.155	0.159	0.182	0.176	0.168	0.161	12.01
40)	T	1-Butanol	0.216	0.202	0.150	0.204	0.237	0.299	0.288	0.271	0.233	21.57
41)	T	Benzene	1.983	1.662	1.180	1.190	1.119	1.217	1.172	1.129	1.332	23.75
42)	T	Carbon Tetrach...	0.411	0.363	0.312	0.342	0.354	0.408	0.394	0.370	0.369	9.26
43)	T	Cyclohexane	0.533	0.445	0.383	0.413	0.429	0.497	0.473	0.448	0.453	10.52
44)	T	tert-Amyl Meth...	0.986	0.810	0.678	0.759	0.785	0.874	0.837	0.823	0.819	10.89
45)	T	1,2-Dichloropr...	0.293	0.317	0.249	0.263	0.266	0.297	0.282	0.269	0.279	7.89
46)	T	Bromodichlorom...	0.432	0.411	0.332	0.368	0.366	0.415	0.399	0.387	0.389	8.34
47)	T	Trichloroethene	0.423	0.370	0.312	0.334	0.338	0.374	0.359	0.358	0.358	9.27
48)	T	1,4-Dioxane	0.290	0.219	0.214	0.216	0.233	0.267	0.252	0.245	0.242	11.06
49)	T	2,2,4-Trimethy...	1.376	1.240	1.003	1.075	1.120	1.250	1.198	1.119	1.173	10.02
50)	T	Methyl Methacr...	0.131	0.097	0.095	0.110	0.119	0.143	0.138	0.137	0.121	15.57
51)	T	n-Heptane	0.307	0.284	0.244	0.264	0.270	0.306	0.296	0.281	0.281	7.71
52)	T	cis-1,3-Dichlo...	0.484	0.397	0.351	0.408	0.424	0.509	0.494	0.480	0.444	12.69
53)	T	4-Methyl-2-pen...	0.234	0.216	0.186	0.213	0.233	0.276	0.257	0.246	0.233	11.97
54)	T	trans-1,3-Dich...	0.388	0.345	0.294	0.338	0.392	0.468	0.444	0.433	0.388	15.34
55)	T	1,1,2-Trichlor...	0.376	0.330	0.271	0.286	0.296	0.327	0.308	0.299	0.312	10.45
56)	IR	Chlorobenzene-d5 (...	----------ISTD----------									
57)	S	Toluene-d8 (SS2)	2.401	2.363	2.418	2.491	2.343	2.370	2.407	2.429	2.403	1.92
58)	T	Toluene	4.064	3.534	2.664	3.102	2.901	3.238	3.163	3.132	3.225	13.09
59)	T	2-Hexanone	1.482	1.009	0.851	1.012	1.073	1.252	1.212	1.164	1.132	16.91
60)	T	Dibromochlorom...	0.852	0.740	0.723	0.752	0.792	0.896	0.872	0.868	0.812	8.41
61)	T	1,2-Dibromoethane	0.950	0.759	0.678	0.734	0.815	0.895	0.856	0.850	0.817	10.98
62)	T	n-Butyl Acetate	1.471	1.189	1.019	1.180	1.276	1.551	1.518	1.477	1.335	14.63
63)	T	n-Octane	0.603	0.546	0.482	0.547	0.539	0.606	0.588	0.576	0.561	7.38
64)	T	Tetrachloroethene	1.190	1.028	0.805	1.003	0.913	1.039	1.008	1.013	1.000	10.98
65)	T	Chlorobenzene	2.554	2.221	1.820	1.941	2.027	2.199	2.097	2.075	2.117	10.39
66)	T	Ethylbenzene	4.119	3.578	2.860	3.138	3.241	3.657	3.549	3.464	3.451	10.99
67)	T	m- & p-Xylenes	3.284	2.680	2.167	2.492	2.525	2.921	2.820	2.749	2.705	12.23
68)	T	Bromoform	0.741	0.639	0.532	0.652	0.672	0.859	0.837	0.847	0.722	16.39
69)	T	Styrene	2.236	1.844	1.767	1.919	1.990	2.431	2.307	2.269	2.095	11.69
70)	T	o-Xylene	3.461	2.671	2.313	2.612	2.626	3.096	2.959	2.903	2.830	12.47

Response Factor Report MS09

Method Path : J:\MS09\Methods\
Method File : R9053012.M
Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)

71)	T	n-Nonane	1.567	1.142	0.973	1.099	1.156	1.323	1.232	1.178	1.209	14.59
72)	T	1,1,2,2-Tetrac...	1.596	1.364	1.201	1.305	1.284	1.446	1.406	1.369	1.371	8.65
73)	S	Bromofluoroben...	0.903	0.870	0.920	0.923	0.888	0.930	0.935	0.928	0.912	2.54
74)	T	Cumene	4.723	3.746	3.160	3.610	3.510	4.084	3.883	3.796	3.814	12.02
75)	T	alpha-Pinene	1.776	1.595	1.464	1.669	1.661	1.964	1.872	1.832	1.729	9.39
76)	T	n-Propylbenzene	5.177	4.222	3.794	4.036	4.207	4.819	4.629	4.460	4.418	10.12
77)	T	3-Ethyltoluene	3.990	3.329	3.021	3.356	3.502	3.962	3.786	3.636	3.573	9.41
78)	T	4-Ethyltoluene	3.786	3.167	2.681	3.105	3.076	3.568	3.524	3.569	3.309	10.95
79)	T	1,3,5-Trimethy...	3.272	2.830	2.331	2.643	2.720	3.112	3.051	2.978	2.867	10.46
80)	T	alpha-Methylst...	1.355	1.028	1.292	1.519	1.588	1.818	1.788	1.761	1.518	18.37
81)	T	2-Ethyltoluene	3.905	3.384	2.978	3.340	3.457	3.896	3.829	3.735	3.565	9.26
82)	T	1,2,4-Trimethy...	2.914	2.568	2.367	2.728	2.780	3.237	3.205	3.130	2.866	10.95
83)	T	n-Decane	1.695	1.444	1.259	1.382	1.395	1.583	1.562	1.486	1.476	9.25
84)	T	Benzyl Chloride	2.083	1.754	1.555	1.840	2.145	2.720	2.776	2.788	2.208	22.38
85)	T	1,3-Dichlorobe...	2.303	1.852	1.564	1.763	1.729	1.967	1.943	1.915	1.880	11.52
86)	T	1,4-Dichlorobe...	2.243	1.877	1.648	1.762	1.730	1.986	1.961	1.954	1.895	9.84
87)	T	sec-Butylbenzene	4.068	3.674	3.208	3.680	3.779	4.327	4.254	4.124	3.889	9.61
88)	T	4-Isopropyltol...	4.030	3.402	3.197	3.619	3.684	4.255	4.177	4.120	3.811	10.27
89)	T	1,2,3-Trimethy...	3.313	2.688	2.477	2.834	2.882	3.267	3.243	3.202	2.988	10.43
90)	T	1,2-Dichlorobe...	2.050	1.907	1.496	1.700	1.677	1.913	1.879	1.871	1.812	9.68
91)	T	d-Limonene	0.866	0.744	0.793	0.947	1.014	1.161	1.147	1.110	0.973	16.61
92)	T	1,2-Dibromo-3-...	0.604	0.542	0.456	0.533	0.591	0.699	0.677	0.688	0.599	14.39
93)	T	n-Undecane	1.320	1.288	1.177	1.333	1.385	1.602	1.533	1.504	1.393	10.22
94)	T	1,2,4-Trichlor...	1.655	1.484	1.085	1.240	1.271	1.486	1.444	1.420	1.386	12.84
95)	T	Naphthalene	5.955	4.540	3.735	4.250	4.589	5.309	5.174	5.085	4.830	14.34
96)	T	n-Dodecane	1.584	1.396	1.129	1.334	1.551	1.728	1.662	1.610	1.499	13.25
97)	T	Hexachlorobuta...	0.976	0.876	0.642	0.762	0.774	0.884	0.863	0.860	0.830	12.18
98)	T	Cyclohexanone	1.217	0.947	0.699	0.810	0.880	1.025	1.001	0.977	0.944	16.36
99)	T	tert-Butylbenzene	3.452	2.827	2.467	2.748	2.872	3.256	3.217	3.141	2.998	10.78
100)	T	n-Butylbenzene	3.350	3.017	2.506	2.785	2.912	3.317	3.212	3.168	3.033	9.54

(#) = Out of Range

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\06\
Data File : 07061201.D
Acq On : 6 Jul 2012 5:54
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
Misc : S25-06141209/S25-06111208
ALS Vial : 16 Sample Multiplier: 1

Quant Time: Jul 06 06:47:20 2012
Quant Method : J:\MS09\Methods\R9053012.M
Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Wed May 30 07:42:16 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	IR	Bromochloromethane (IS1)	1.000	1.000	0.0	100	0.00
2	T	Propene	1.216	1.466	-20.6	95	0.00
3	T	Dichlorodifluoromethane (CF	2.567	2.866	-11.6	105	0.00
4	T	Chloromethane	1.643	2.101	-27.9	121	0.00
5	T	1,2-Dichloro-1,1,2,2-tetraf	1.511	1.600	-5.9	104	0.00
6	T	Vinyl Chloride	1.794	2.061	-14.9	109	0.00
7	T	1,3-Butadiene	1.214	1.353	-11.4	99	0.00
8	T	Bromomethane	1.295	1.329	-2.6	101	0.00
9	T	Chloroethane	0.868	0.929	-7.0	102	0.00
10	T	Ethanol	0.784	0.878	-12.0	107	0.00
11	T	Acetonitrile	1.585	1.793	-13.1	105	0.00
12	T	Acrolein	0.598	0.648	-8.4	99	0.00
13	T	Acetone	0.754	0.822	-9.0	99	0.00
14	T	Trichlorofluoromethane	2.272	2.530	-11.4	107	0.00
15	T	2-Propanol (Isopropanol)	1.753	2.318	-32.2#	134	0.00
16	T	Acrylonitrile	1.160	1.440	-24.1	105	0.00
17	T	1,1-Dichloroethene	1.222	1.254	-2.6	100	0.00
18	T	2-Methyl-2-Propanol (tert-B	2.299	2.944	-28.1	119	0.00
19	T	Methylene Chloride	1.255	1.299	-3.5	100	0.00
20	T	3-Chloro-1-propene (Allyl C	1.323	1.452	-9.8	98	0.00
21	T	Trichlorotrifluoroethane	1.126	1.159	-2.9	97	0.00
22	T	Carbon Disulfide	4.495	4.845	-7.8	103	0.00
23	T	trans-1,2-Dichloroethene	1.599	1.791	-12.0	103	0.00
24	T	1,1-Dichloroethane	1.986	2.159	-8.7	101	0.00
25	T	Methyl tert-Butyl Ether	3.438	3.832	-11.5	103	0.00
26	T	Vinyl Acetate	0.233	0.296	-27.0	101	0.00
27	T	2-Butanone (MEK)	0.674	0.824	-22.3	103	0.00
28	T	cis-1,2-Dichloroethene	1.546	1.714	-10.9	105	0.00
29	T	Diisopropyl Ether	1.000	1.076	-7.6	102	0.00
30	T	Ethyl Acetate	0.384	0.475	-23.7	105	0.00
31	T	n-Hexane	1.870	2.058	-10.1	99	0.00
32	T	Chloroform	2.033	2.250	-10.7	108	0.00
33	S	1,2-Dichloroethane-d4(SS1)	1.169	1.357	-16.1	116	0.00
34	T	Tetrahydrofuran (THF)	0.725	0.816	-12.6	106	0.00
35	T	Ethyl tert-Butyl Ether	1.418	1.560	-10.0	102	0.00
36	T	1,2-Dichloroethane	1.497	1.740	-16.2	113	0.00
37	IR	1,4-Difluorobenzene (IS2)	1.000	1.000	0.0	105	0.00
38	T	1,1,1-Trichloroethane	0.461	0.492	-6.7	106	0.00

 DA 7/6/12

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\06\
Data File : 07061201.D
Acq On : 6 Jul 2012 5:54
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
Misc : S25-06141209/S25-06111208
ALS Vial : 16 Sample Multiplier: 1

Quant Time: Jul 06 06:47:20 2012
Quant Method : J:\MS09\Methods\R9053012.M
Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Wed May 30 07:42:16 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
39	T	Isopropyl Acetate	0.161	0.179	-11.2	104	0.00
40	T	1-Butanol	0.233	0.290	-24.5	102	0.00
41	T	Benzene	1.332	1.193	10.4	103	0.00
42	T	Carbon Tetrachloride	0.369	0.403	-9.2	104	0.00
43	T	Cyclohexane	0.453	0.471	-4.0	100	0.00
44	T	tert-Amyl Methyl Ether	0.819	0.879	-7.3	106	0.00
45	T	1,2-Dichloropropane	0.279	0.289	-3.6	102	0.00
46	T	Bromodichloromethane	0.389	0.407	-4.6	103	0.00
47	T	Trichloroethene	0.358	0.369	-3.1	104	0.00
48	T	1,4-Dioxane	0.242	0.255	-5.4	100	0.00
49	T	2,2,4-Trimethylpentane (Iso	1.173	1.205	-2.7	101	0.00
50	T	Methyl Methacrylate	0.121	0.136	-12.4	100	0.00
51	T	n-Heptane	0.281	0.296	-5.3	102	0.00
52	T	cis-1,3-Dichloropropene	0.444	0.492	-10.8	101	0.00
53	T	4-Methyl-2-pentanone	0.233	0.265	-13.7	101	0.00
54	T	trans-1,3-Dichloropropene	0.388	0.462	-19.1	104	0.00
55	T	1,1,2-Trichloroethane	0.312	0.318	-1.9	102	0.00
56	IR	Chlorobenzene-d5 (IS3)	1.000	1.000	0.0	109	0.00
57	S	Toluene-d8 (SS2)	2.403	2.292	4.6	105	0.00
58	T	Toluene	3.225	3.007	6.8	101	0.00
59	T	2-Hexanone	1.132	1.187	-4.9	103	0.00
60	T	Dibromochloromethane	0.812	0.833	-2.6	101	0.00
61	T	1,2-Dibromoethane	0.817	0.830	-1.6	101	0.00
62	T	n-Butyl Acetate	1.335	1.473	-10.3	103	0.00
63	T	n-Octane	0.561	0.567	-1.1	102	0.00
64	T	Tetrachloroethene	1.000	0.932	6.8	98	0.00
65	T	Chlorobenzene	2.117	2.005	5.3	99	0.00
66	T	Ethylbenzene	3.451	3.409	1.2	102	0.00
67	T	m- & p-Xylenes	2.705	2.698	0.3	101	0.00
68	T	Bromoform	0.722	0.785	-8.7	100	0.00
69	T	Styrene	2.095	2.169	-3.5	97	0.00
70	T	o-Xylene	2.830	2.835	-0.2	100	0.00
71	T	n-Nonane	1.209	1.237	-2.3	102	0.00
72	T	1,1,2,2-Tetrachloroethane	1.371	1.319	3.8	99	0.00
73	S	Bromofluorobenzene (SS3)	0.912	1.024	-12.3	120	0.00
74	T	Cumene	3.814	3.757	1.5	100	0.00
75	T	alpha-Pinene	1.729	1.746	-1.0	97	0.00
76	T	n-Propylbenzene	4.418	4.512	-2.1	102	0.00

 DA 7/6/12

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\06\
Data File : 07061201.D
Acq On : 6 Jul 2012 5:54
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
Misc : S25-06141209/S25-06111208
ALS Vial : 16 Sample Multiplier: 1

Quant Time: Jul 06 06:47:20 2012
Quant Method : J:\MS09\Methods\R9053012.M
Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Wed May 30 07:42:16 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
77	T	3-Ethyltoluene	3.573	3.757	-5.1	103	0.00
78	T	4-Ethyltoluene	3.309	3.321	-0.4	101	0.00
79	T	1,3,5-Trimethylbenzene	2.867	2.937	-2.4	103	0.00
80	T	alpha-Methylstyrene	1.518	1.639	-8.0	98	0.00
81	T	2-Ethyltoluene	3.565	3.647	-2.3	102	0.00
82	T	1,2,4-Trimethylbenzene	2.866	3.078	-7.4	104	0.00
83	T	n-Decane	1.476	1.513	-2.5	104	0.00
84	T	Benzyl Chloride	2.208	2.566	-16.2	103	0.00
85	T	1,3-Dichlorobenzene	1.880	1.818	3.3	101	0.00
86	T	1,4-Dichlorobenzene	1.895	1.834	3.2	101	0.00
87	T	sec-Butylbenzene	3.889	4.035	-3.8	102	0.00
88	T	4-Isopropyltoluene (p-Cymen	3.811	4.002	-5.0	102	0.00
89	T	1,2,3-Trimethylbenzene	2.988	3.125	-4.6	104	0.00
90	T	1,2-Dichlorobenzene	1.812	1.785	1.5	102	0.00
91	T	d-Limonene	0.973	1.083	-11.3	102	0.00
92	T	1,2-Dibromo-3-Chloropropane	0.599	0.628	-4.8	98	0.00
93	T	n-Undecane	1.393	1.523	-9.3	104	0.00
94	T	1,2,4-Trichlorobenzene	1.386	1.369	1.2	100	0.00
95	T	Naphthalene	4.830	5.123	-6.1	105	0.00
96	T	n-Dodecane	1.499	1.673	-11.6	105	0.00
97	T	Hexachlorobutadiene	0.830	0.804	3.1	99	0.00
98	T	Cyclohexanone	0.944	0.896	5.1	95	0.00
99	T	tert-Butylbenzene	2.998	3.033	-1.2	101	0.00
100	T	n-Butylbenzene	3.033	3.161	-4.2	104	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 0

 7/6/12

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\09\
Data File : 07091202.D
Acq On : 9 Jul 2012 5:42
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
Misc : S25-06141209/S25-06111208
ALS Vial : 16 Sample Multiplier: 1

Quant Time: Jul 09 06:23:07 2012
Quant Method : J:\MS09\Methods\R9053012.M
Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Wed May 30 07:42:16 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
1	IR	Bromochloromethane (IS1)	1.000	1.000	0.0	108	0.00
2	T	Propene	1.216	1.417	-16.5	99	-0.01
3	T	Dichlorodifluoromethane (CF	2.567	2.844	-10.8	113	-0.01
4	T	Chloromethane	1.643	2.021	-23.0	126	-0.01
5	T	1,2-Dichloro-1,1,2,2-tetraf	1.511	1.592	-5.4	111	0.00
6	T	Vinyl Chloride	1.794	2.189	-22.0	125	-0.01
7	T	1,3-Butadiene	1.214	1.382	-13.8	109	0.00
8	T	Bromomethane	1.295	1.364	-5.3	112	-0.01
9	T	Chloroethane	0.868	0.925	-6.6	109	0.00
10	T	Ethanol	0.784	0.882	-12.5	117	0.00
11	T	Acetonitrile	1.585	1.757	-10.9	111	-0.01
12	T	Acrolein	0.598	0.644	-7.7	107	0.00
13	T	Acetone	0.754	0.806	-6.9	105	0.00
14	T	Trichlorofluoromethane	2.272	2.521	-11.0	115	0.00
15	T	2-Propanol (Isopropanol)	1.753	2.422	-38.2#	151	-0.01
16	T	Acrylonitrile	1.160	1.418	-22.2	112	0.00
17	T	1,1-Dichloroethene	1.222	1.296	-6.1	111	0.00
18	T	2-Methyl-2-Propanol (tert-B	2.299	2.911	-26.6	127	0.00
19	T	Methylene Chloride	1.255	1.313	-4.6	109	0.00
20	T	3-Chloro-1-propene (Allyl C	1.323	1.443	-9.1	106	0.00
21	T	Trichlorotrifluoroethane	1.126	1.217	-8.1	110	0.00
22	T	Carbon Disulfide	4.495	4.891	-8.8	112	0.00
23	T	trans-1,2-Dichloroethene	1.599	1.797	-12.4	112	0.00
24	T	1,1-Dichloroethane	1.986	2.133	-7.4	107	0.00
25	T	Methyl tert-Butyl Ether	3.438	3.805	-10.7	110	0.00
26	T	Vinyl Acetate	0.233	0.287	-23.2	106	0.00
27	T	2-Butanone (MEK)	0.674	0.818	-21.4	110	0.00
28	T	cis-1,2-Dichloroethene	1.546	1.693	-9.5	112	0.00
29	T	Diisopropyl Ether	1.000	1.069	-6.9	110	0.00
30	T	Ethyl Acetate	0.384	0.468	-21.9	111	0.00
31	T	n-Hexane	1.870	2.081	-11.3	109	0.00
32	T	Chloroform	2.033	2.206	-8.5	115	0.00
33	S	1,2-Dichloroethane-d4(SS1)	1.169	1.323	-13.2	122	0.00
34	T	Tetrahydrofuran (THF)	0.725	0.809	-11.6	114	0.00
35	T	Ethyl tert-Butyl Ether	1.418	1.566	-10.4	111	0.00
36	T	1,2-Dichloroethane	1.497	1.700	-13.6	119	0.00
37	IR	1,4-Difluorobenzene (IS2)	1.000	1.000	0.0	114	0.00
38	T	1,1,1-Trichloroethane	0.461	0.485	-5.2	114	0.00

7/9/12

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\09\
Data File : 07091202.D
Acq On : 9 Jul 2012 5:42
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
Misc : S25-06141209/S25-06111208
ALS Vial : 16 Sample Multiplier: 1

Quant Time: Jul 09 06:23:07 2012
Quant Method : J:\MS09\Methods\R9053012.M
Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
QLast Update : Wed May 30 07:42:16 2012
Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

		Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
39	T	Isopropyl Acetate	0.161	0.179	-11.2	112	0.00
40	T	1-Butanol	0.233	0.291	-24.9	111	0.00
41	T	Benzene	1.332	1.173	11.9	110	0.00
42	T	Carbon Tetrachloride	0.369	0.398	-7.9	111	0.00
43	T	Cyclohexane	0.453	0.471	-4.0	108	0.00
44	T	tert-Amyl Methyl Ether	0.819	0.858	-4.8	112	0.00
45	T	1,2-Dichloropropane	0.279	0.291	-4.3	112	0.00
46	T	Bromodichloromethane	0.389	0.412	-5.9	113	0.00
47	T	Trichloroethene	0.358	0.365	-2.0	111	0.00
48	T	1,4-Dioxane	0.242	0.256	-5.8	109	0.00
49	T	2,2,4-Trimethylpentane (Iso	1.173	1.185	-1.0	108	0.00
50	T	Methyl Methacrylate	0.121	0.138	-14.0	110	0.00
51	T	n-Heptane	0.281	0.295	-5.0	110	0.00
52	T	cis-1,3-Dichloropropene	0.444	0.500	-12.6	112	0.00
53	T	4-Methyl-2-pentanone	0.233	0.264	-13.3	109	0.00
54	T	trans-1,3-Dichloropropene	0.388	0.455	-17.3	111	0.00
55	T	1,1,2-Trichloroethane	0.312	0.314	-0.6	110	0.00
56	IR	Chlorobenzene-d5 (IS3)	1.000	1.000	0.0	120	0.00
57	S	Toluene-d8 (SS2)	2.403	2.334	2.9	118	0.00
58	T	Toluene	3.225	3.028	6.1	112	0.00
59	T	2-Hexanone	1.132	1.169	-3.3	112	0.00
60	T	Dibromochloromethane	0.812	0.833	-2.6	111	0.00
61	T	1,2-Dibromoethane	0.817	0.812	0.6	108	0.00
62	T	n-Butyl Acetate	1.335	1.467	-9.9	113	0.00
63	T	n-Octane	0.561	0.567	-1.1	112	0.00
64	T	Tetrachloroethene	1.000	0.938	6.2	108	0.00
65	T	Chlorobenzene	2.117	1.994	5.8	108	0.00
66	T	Ethylbenzene	3.451	3.396	1.6	111	0.00
67	T	m- & p-Xylenes	2.705	2.680	0.9	110	0.00
68	T	Bromoform	0.722	0.759	-5.1	106	0.00
69	T	Styrene	2.095	2.122	-1.3	104	0.00
70	T	o-Xylene	2.830	2.778	1.8	107	0.00
71	T	n-Nonane	1.209	1.205	0.3	109	0.00
72	T	1,1,2,2-Tetrachloroethane	1.371	1.298	5.3	107	0.00
73	S	Bromofluorobenzene (SS3)	0.912	1.025	-12.4	132	0.00
74	T	Cumene	3.814	3.650	4.3	107	0.00
75	T	alpha-Pinene	1.729	1.737	-0.5	106	0.00
76	T	n-Propylbenzene	4.418	4.419	-0.0	110	0.00

 7/9/12

Evaluate Continuing Calibration Report

Data Path : J:\MS09\Data\2012_07\09\
Data File : 07091202.D
Acq On : 9 Jul 2012 5:42
Operator : WA
Sample : 25ng TO-15 CCV STD (125mL)
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Quant Title : EPA TO-15 per SOP VOA-TO15 (CASS TO-15/GC-MS)
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Response via : Initial Calibration

Min. RRF : 0.000 Min. Rel. Area : 50% Max. R.T. Dev 0.33min
Max. RRF Dev : 30% Max. Rel. Area : 200%

	Compound	AvgRF	CCRF	%Dev	Area%	Dev(min)
77 T	3-Ethyltoluene	3.573	3.673	-2.8	111	0.00
78 T	4-Ethyltoluene	3.309	3.350	-1.2	112	0.00
79 T	1,3,5-Trimethylbenzene	2.867	2.881	-0.5	111	0.00
80 T	alpha-Methylstyrene	1.518	1.614	-6.3	106	0.00
81 T	2-Ethyltoluene	3.565	3.601	-1.0	111	0.00
82 T	1,2,4-Trimethylbenzene	2.866	3.012	-5.1	111	0.00
83 T	n-Decane	1.476	1.471	0.3	111	0.00
84 T	Benzyl Chloride	2.208	2.520	-14.1	111	0.00
85 T	1,3-Dichlorobenzene	1.880	1.802	4.1	110	0.00
86 T	1,4-Dichlorobenzene	1.895	1.831	3.4	110	0.00
87 T	sec-Butylbenzene	3.889	4.010	-3.1	111	0.00
88 T	4-Isopropyltoluene (p-Cymen	3.811	3.966	-4.1	111	0.00
89 T	1,2,3-Trimethylbenzene	2.988	3.106	-3.9	114	0.00
90 T	1,2-Dichlorobenzene	1.812	1.750	3.4	109	0.00
91 T	d-Limonene	0.973	1.067	-9.7	110	0.00
92 T	1,2-Dibromo-3-Chloropropane	0.599	0.614	-2.5	105	0.00
93 T	n-Undecane	1.393	1.486	-6.7	111	0.00
94 T	1,2,4-Trichlorobenzene	1.386	1.332	3.9	107	0.00
95 T	Naphthalene	4.830	4.964	-2.8	112	0.00
96 T	n-Dodecane	1.499	1.639	-9.3	113	0.00
97 T	Hexachlorobutadiene	0.830	0.778	6.3	105	0.00
98 T	Cyclohexanone	0.944	0.862	8.7	101	0.00
99 T	tert-Butylbenzene	2.998	2.984	0.5	110	0.00
100 T	n-Butylbenzene	3.033	3.116	-2.7	112	0.00

(#) = Out of Range SPCC's out = 0 CCC's out = 0

Appendix O: Laboratory Operating Procedures

SOP for CO2 and CO Collected in Canisters and Analyzed by USEPA 25C Modified

ALS Environmental

DOCUMENT TITLE:	DETERMINATION OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, AND TOTAL GASEOUS NONMETHANE ORGANIC (TGNMO) EMISSIONS AS CARBON IN LANDFILL GASES ACCORDING TO MODIFIED EPA METHOD 25C
REFERENCED METHOD:	EPA 25C MODIFIED
SOP ID:	VOA-EPA25CM
REV. NUMBER:	10.0
EFFECTIVE DATE:	01/19/2013

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DETERMINATION OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, AND TOTAL GASEOUS NONMETHANE ORGANIC (TGNMO) EMISSIONS AS CARBON IN LANDFILL GASES ACCORDING TO MODIFIED EPA METHOD 25C

EPA 25C MODIFIED

SOPID:	VOA-EPA25CM	Rev. Number:	10.0	Effective Date:	01/19/2013

Approved By: _____ Date: 1/3/13
VOA Team Leader - Wade Henton

Approved By: _____ Date: 1/3/13
QA Manager - Chaney Humphrey

Approved By: _____ Date: 01/04/13
Laboratory Director - Kelly Horiuchi

Archival Date: _____ Doc Control ID#: Non-Controlled Editor: _____

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DETERMINATION OF METHANE, CARBON MONOXIDE, CARBON DIOXIDE, AND TOTAL GASEOUS NONMETHANE ORGANIC (TGNMO) EMISSIONS AS CARBON IN LANDFILL GASES ACCORDING TO MODIFIED EPA METHOD 25COF ARGON USING GAS CHROMATOGRAPHY WITH THERMAL CONDUCTIVITY DETECTION (TCD)

1) Scope and Applicability

1.1 This gas chromatographic method is used in the determination of CO, CH_4, CO_2, and Total Gaseous Non-Methane Organics (TGNMO) as carbon in municipal solid waste landfill gas and other stationary sources. This method includes the procedure and is appropriate for referencing modified methods EPA 25C and SCAQMD 25.1. It is appropriate for quantifying target analyte gases depending on the concentration of the samples from approximately 1ppm to low percent levels. This method is not applicable for the determination of organic particulate matter.

The number of samples which may be analyzed in one eight hour day is approximately twenty. The method detection and reporting limits for these analytes are listed in Attachment A of this standard operating procedure.

2) Summary of Procedure

2.1 This method is essentially similar to other published methods that measure non-methane organic compounds (NMOC) or TGNMO from municipal solid waste landfills; however, it differs from the aforementioned methods in that it does not attempt to measure condensable NMOC using a separate condensate trap device.

The air sample is collected in a stainless steel tank, specially prepared canister, or sample collection bag. Using a gas chromatographic column, the CO, CH_4 and CO_2 are separated from the non-methane organic gases. After total elution of the carbon dioxide peak the direction of the carrier gas is reversed and the temperature of the chromatographic column is ramped, thereby backflushing the non-methane organics from the head of the column. The NMOC is eluted through an oxidizer converting the NMOC to carbon dioxide, then eluted through a reducer, which converts the NMOC to methane (the other analytes follow this path as well). The resulting methane peak is measured using a flame ionization detector (FID) and this technique is referred to as "total combustion analysis". Since the non-methane organic compound content of the gas is stoichiometrically converted to carbon dioxide, then to methane, it virtually eliminates the negative bias caused by the variable response of hydrocarbons and most notably substituted hydrocarbons.

This document entails a method modification whereby the initial calibration standards (five or more points) and the submitted field samples are analyzed using a single injection. In addition, this modification includes the analysis of carbon monoxide, methane and carbon dioxide.

3) Definitions

3.1 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

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3.2 Field Sample A sample collected and delivered to the laboratory for analysis.

3.3 Batch QC Batch QC refers to the QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) and Laboratory Duplicate (LD).

3.4 Calibration Standard (Initial Calibration – ICAL) A calibration standard is a known concentration of desired analyte(s) prepared from a primary standard, which is, in turn, prepared from a stock standard material. A calibration standard is analyzed at varying concentrations and used to calibrate the response of the measurement system with respect to analyte concentration.

3.5 Initial Calibration Verification (ICV) Standard An ICV is a standard that is prepared from materials obtained from a source other than the source for the calibration standards and is analyzed after the measurement system is calibrated, but prior to sample analysis in order to verify the calibration of the measurement system.

3.6 Method Blank (MB) An analyte-free matrix which is carried through the entire analytical process. It is used to evaluate the process for contamination from the laboratory.

3.7 Laboratory Control Sample (LCS) For the purposes of this document, a laboratory control sample shall be a calibration standard of known quantity and an alternate source to the standard used for the initial calibration. The percent recovery of the analyte(s) in the LCS is used to assess method performance.

3.8 External Standard Calibration External standard calibration involves comparison of instrument responses from the sample to the responses from the target compounds in the calibration standards. Sample peak areas or peak heights are compared to peak areas or peak heights of the standards.

3.9 Analytical Batch A group of samples which behave similarly with respect to the sampling or the test procedures being employed and are processed as a unit using the sample lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. In an analytical batch of samples, the time period is 24 hours or up to twenty sample injections, whichever comes first of continuous operation without interruption.

3.10 Continuing Calibration Verification (CCV) Standard A continuing calibration verification standard is a calibration standard, usually midrange, but it may be varied, that is analyzed periodically to verify the continuing calibration of the measurement system.

3.11 Precision Precision of a method is how close results are to one another, and is usually expressed by measures such as standard deviation, which describes the spread of results.

3.12 Bias The bias of a method is an expression of how close the mean of a set of results (produced by the method) is to the true value.

3.13 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have

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been adjusted; peak integration start and stop "ticks" have been changed; peak area, or peak height are changed after the initial time of data collection and data file generation.

4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are to be performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory described in section 18 and the *SOP for Training Policy.* Final review and sign-off of the data is performed by the department supervisor/manager or designee.

4.2 It is the responsibility of the department supervisor to document analyst training and to document method proficiency whenever significant changes in the procedure or instrumentation are made.

5) Interferences

5.1 Contamination

5.1.1 Column Conditioning Conditioning of the chromatographic column is required prior to use of the system. The column should be conditioned with a continuous flow of chromatographic grade helium and temperature programmed from ambient to 200°C at a rate of five degrees per minute. The column temperature should be held at 200°C for at least four hours.

5.1.2 Contamination in the Sample Care must be taken to prevent ambient air intrusion into the sample container during canister pressurization and laboratory analysis. Flush the sample loop for approximately ten seconds with sample prior to injection. Also, when using adapters and fittings the dead volume should be evacuated using the sample loop and pump for approximately ten seconds prior to sampling from the container.

5.1.3 Carrier Gas Contamination To prevent contamination, UHP/ZERO grade helium (99.999% purity) is used as the carrier gas. Also, a purifier and an oxygen trap are incorporated into the analytical system as additional insurance against possible contamination.

5.1.4 Catalyst Conditioning It is essential that catalysts be free of all contaminants. In particular, the reducing catalyst must be conditioned with hydrogen at an operating temperature (400°C) for a minimum of 24 hours prior to start up or until the baseline indicates satisfactory performance. Failure to perform column or catalyst conditioning prior to analysis may result in a rising baseline detected upon system backflush.

5.1.5 Canister Pressurization Care must be taken to prevent ambient air intrusion into the sample container during canister pressurization and laboratory analysis. Perform sample pressurization with helium in accordance with the *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters.*

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5.2 Sulfur

A typical sample of municipal solid waste (MSW) landfill gas contains 5 to 80 parts per million (ppm) of hydrogen sulfide. High concentrations (in excess of 100ppm) of hydrogen sulfide or other sulfur containing compounds may damage the reducing catalyst.

If an analyst suspects, based on Client sample history and type of sample, that a sample of landfill gas contains or may contain concentrations in excess of 50ppm of sulfur containing compounds it should be brought to the attention of the Project Manager (PM). The PM, along with the client, shall decide on the appropriate approach for the analysis of the sample depending on the mitigating circumstances. This may include injection with a small sample loop, a dilution of the sample gas or recommendation of the use of a more appropriate method of analysis for the sample in question.

5.3 Peak Saturation and Column Overload

5.3.1 High Methane and Carbon Dioxide Samples

A typical municipal solid waste (MSW) landfill gas sample contains 30 to 60% methane (CH_4) and 20 to 40% carbon dioxide (CO_2) by volume. Samples, which contain these amounts of CH_4 and CO_2, injected directly will damage the reducing catalyst (see Section 8.1.6) due to sudden carbonization.

If the sample analysis requires methane and carbon dioxide, prior to analysis by this method, the samples shall be screened by injection of the sample using GC/TCD in accordance with modified EPA Method 3C (single injection). If samples are screened and contain methane and carbon dioxide at concentrations greater than 0.5% they are analyzed using a heart-cut technique that selectively vents methane and/or carbon dioxide while quantitatively retaining the entire NMOC portion of the sample. However, if methane or carbon dioxide is not required, screening is not necessary but the heart cut technique used as a precaution. Refer to Section 11.10.1 for the appropriate procedure.

Note: High levels of carbon dioxide may interfere with the TGNMO peak and produce a bias high result. If this is the case a smaller injection loop should be used.

5.3.2 Heavy Hydrocarbons or Complex Matrices

Landfill gas samples containing heavy hydrocarbon or complex matrices may produce chromatograms exhibiting broad tailing of the NMOC peak. If the amplitude of the signal has not returned to the normal baseline at the conclusion of the analysis the resulting NMOC concentration will be biased low. The system must be conditioned until it returns to acceptable status. The sample shall be reanalyzed with an extended run time during the backflush cycle such that the amplitude of the signal returns to the normal baseline at the conclusion of the run.

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6) Safety

6.1 All compounds, mixture of compounds and standards, as well as samples, should be treated as a potential health hazard. Exposure to these chemicals should be reduced to the lowest level possible through the use of gloves (to minimize absorption through the skin) and hoods (to minimize inhalation). For proper handing, use and disposal refer to the laboratory's Environmental, Health and Safety Manual, MSDS (located in the conference room), as well as the *SOP for Waste Disposal*.

6.2 Material Safety Data Sheets (MSDS) Material safety data sheets (MSDS) are available and should be reviewed as part of employee training.

6.3 Protective Clothing Personal protective clothing (at a minimum, safety glasses and gloves) are required when preparing standards or performing maintenance on pressurized systems.

6.4 Pressurized Gases The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp at all times. The regulator should not remain on size "D" cylinders when not in use. Sources of flammable gases (i.e. pressurized hydrogen) should be clearly labeled.

7) Sample Collection, Containers, Preservation, and Storage

7.1 Samples that are to be sampled in specially prepared canisters must be properly conditioned. If necessary or at the client's request, the samples are backfilled with helium prior to shipment to the field. Samples that are collected in bags must be analyzed within 72 hours after sample collection unless otherwise specified by the client. Samples delivered in cleaned and evacuated summa or other specially prepared canisters do not have specified holding times for atmospheric gases, but our laboratory recommends that samples be analyzed within 30 days from the date of collection.

8) Apparatus and Equipment

8.1 Gas Chromatograph

The analysis is performed using a Hewlett-Packard model 5890 Series II gas chromatograph or equivalent equipped with three computer controlled valves and a flame ionization detector.

8.1.1 Column 4' x 1/8" stainless steel column packed with 60/80-mesh Tenax/Haysep Q/Carbosphere or equivalent.

8.1.2 Sampling Pump The pump is used to draw the sample from the sample container and flush through the sampling loop.

8.1.3 Sample Loop Stainless steel tubing with a 500µL internal volume (52.2µL loop is used to analyze high concentration samples).

8.1.4 Conditioning System The system is able to maintain the column and sample loop at a constant temperature.

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8.1.5 Oxidation Catalyst The oxidation catalyst is comprised of approximately 1¼" of hopcolite followed by a 1:1 mixture of chromium oxide III powder and chromsorb WP followed by another 1¼" of hopcolite in ¼" inconel tubing. The catalyst is then heated to 590°C.

8.1.6 Reduction Catalyst The reduction catalyst is comprised of approximately 3" of equal amounts of Raney 2800, nickel powder and PAW packed in ¼" inconel tubing, heated to 425°C.

8.1.7 Sample Adapters Appropriate adapters are used to enable sampling from sample containers to the sample loop.

8.1.8 Flame Ionization Detector

9) Standards, Reagents, and Consumable Materials

9.1 All samples, standards, and media must be stored separately. The concentration, preparation and expiration date as well as analyst's initials must be identified on the standard label. Each standard must also be uniquely identified with a laboratory ID number.

9.2 All certificates shall be maintained (turned in to quality assurance) and noted with the standard identification number, date received and initials of the receiving analyst. For additional information on these and other requirements, refer to the *SOP for Handling Consumable Materials*.

9.3 Carrier and Calibration Standard and Field Sample Balance Gas

The requirement for helium is UHP/ZERO (99.999%) or higher in purity

9.4 Purchased Stock Standards

These standards must be stored and maintained in accordance with the requirements described in the *SOP for Handling Consumable Materials*. These purchased standards may be stored for a period of two years or as recommended by the manufacturer.

9.4.1 Scott Specialty Gas (or similar)

Compound	Concentration
Hydrogen	4%
Oxygen	5%
Nitrogen	5%
Carbon monoxide	5%
Methane	4%
Carbon dioxide	5%
Balance gas:	*Helium*

Note: the exact concentrations may change with each acquired standard.

9.4.2 Scott Specialty Gas (or similar)

Compound	Concentration

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Propane 99%

OR

Propene *99%*

Note: the exact concentrations may change with each acquired standard.

9.4.3 Hexane 99% purity

9.4.4 Toluene ACS reagent grade

9.4.5 Methanol Purge and trap grade

9.5 Calibration Standards

All canisters used to contain standards shall be prepared in accordance with the *SOP for Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters.*

9.5.1 Initial Calibration Standards Initial calibration standards shall be prepared to cover the concentration range that is desired for the initial calibration. The ICAL standards at concentrations of 4ppmV and 100ppmV (nominal, balance gas: zero grade air) shall be prepared in summa canisters and stored at ambient temperatures. Another standard covering the upper end of the calibration curve shall be made in either a summa canister or tedlar sampling bag.

Differing volumes, utilizing these three standards, shall make up the points on the calibration curve. In addition, other concentrations may be prepared as long as the initial calibration requirements are followed.

9.5.2 Initial Calibration Verification Standard (ICV) The ICV is required to be from a source other than the source of the calibration standards (manufacturer or lot). The ICV shall be prepared from the purchased standard described in Section 9.4.1 and 9.4.2. An approximate concentration of 100ppmV standard shall be prepared in a summa canister with helium as the balance gas. This standard shall be stored at ambient temperatures.

9.5.3 Continuing Calibration Verification Standard Differing injection volumes of the initial calibration standards prepared in Section 9.5.1 may be used to verify the initial calibration.

9.6 System Performance Check Standards

9.6.1 Hexane Prepare a 50ppm hexane standard (balance gas: zero grade air) in a Tedlar bag or Summa canister utilizing the purchased hexane standard detailed in Section 9.4.3.

9.6.2 Toluene Prepare a 20ppm toluene standard (balance gas: zero grade air) in a Tedlar bag or Summa canister utilizing the purchased toluene detailed in Section 9.4.4.

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9.6.3 Methanol Prepare a 100ppm methanol standard (purge and trap grade, balance gas: zero grade air) in a Tedlar bag or Summa canister utilizing the purchased methanol detailed in Section 9.4.5.

9.7 Storage and Expiration Dates

An expiration date shall be assigned by the analyst according to the *SOP for Handling Consumable Materials* for standards. This is done only if the manufacturer did not assign an expiration date.

9.7.1 Stock Standards

The stock standards are purchased in gas cylinders and are stored at an ambient temperature for a period of five years for *Neat* standards and two years for *VOC Gas Phase Stock Standards* or as recommended by the manufacturer.

9.7.2 Calibration Standards (ICAL, ICV and CCV)

Store each standard at an ambient temperature for a period detailed below, depending on the container.

Summa or Other Specially Prepared Canister - two years
Tedlar Bag - 72 hours

9.7.3 System Performance Check Standards

- 50ppm Hexane – Store at an ambient temperature for a period of 72 hours
- 20ppm Toluene - Store at an ambient temperature for a period of 72 hours
- 100ppm Methanol - Store at an ambient temperature for a period of 72 hours

9.8 Gases

Gases (helium, air, hydrogen and nitrogen) shall be stored at ambient temperatures for a period of two years or as recommended by the manufacturer.

10) Preventive Maintenance

10.1 A maintenance log shall be kept documenting maintenance performed on each analytical system and the instrument maintenance log must be kept current. The serial numbers of each instrument shall be recorded in the front of the logbook. Entries shall be made in the appropriate log every time maintenance is performed (no matter how significant). It is important that a notation be included for each maintenance activity such as changing a column or catalyst, or cleaning the detector. The entry in the log must include:

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(a) The date of maintenance
(b) Who did the maintenance
(c) Description of the maintenance
(d) Proof that the maintenance activity was successful

A notation of a successful continuing calibration or initial calibration shall serve as proof that the maintenance is complete and the instrument is in working order.

10.2 Carrier Gas Purifier

If in-line purifiers or scrubbers are in place they must be changed as needed or as recommended by the supplier.

10.3 GC System

Column performance should be monitored by observing peak shapes and column bleed. Over time, the column may exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur depends on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced (see Section 8.1.1). Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

10.4 Catalysts

Replace the oxidizing and/or reducing catalysts as needed and perform an efficiency check as described in the EPA 25C Method.

11) Procedure

11.1 Sufficient raw data records of the analysis, instrument calibrations and method detection limit studies must be retained including: analysis/calibration date and time, test method, instrument, sample identification, each analyte name, analyst's initials, concentration and response, and standards used for the analysis and calibrations, manual integrations and all manual calculations including sample dilutions. Make sure that all information entered and reported on the quantitation report and instrument run log is complete and accurate.

11.2 Analytical Sequence and Data System Setup

11.2.1 Data System Load the appropriate acquisition method file for the gas chromatograph temperature program. Load the appropriate analytical sequence and enter the analytical sequence information in the table window, including standard name, sample name and injection volume. Load the appropriate quantitation method file. Run the sequence and inject the standards and samples per the guidelines detailed in Section 11.2.2 below.

11.2.2 Analytical Sequence The analytical batch must be completed for the analysis of ≤20 field samples.

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Analytical Sequence Guideline[1]

Sample Description(w/ICAL)	*Sample Description*
Calibration Stds.[2]	CCV[3]
ICV[4]	MB[5]
MB[5]	Lab Air[6]
Lab Air[6]	LCS[7]
Samples 1-10[8]	Samples 1-10[8]
CCV[3]	CCV[3]
Samples 11-19[8]	Samples 11-19[8]
LD[9]	LD[9]
CCV[3]	CCV[3]

[1]The batch QC may be analyzed in an order other than the one listed in this document; the analytical sequence specified below is a guideline.
[2]The initial calibration must be generated in accordance with the guidelines detailed in Section 11.7.2 of this document.
[3]In cases where the ICAL is not performed the analytical sequence must begin with the analysis of a CCV standard. In an external standard calibration the CCV is to be analyzed no less frequently then every ten samples and the analytical sequence is to end with the analysis of a CCV standard.
[4]Every ICAL must be followed by a second source standard (ICV) which contains all of the target analytes. Also serves as the LCS.
[5]The method blank must be carried throughout the entire analytical process and be analyzed prior to any samples within the sequence. In addition, a method blank (MB) shall be run to monitor for laboratory introduced contamination.
[6]A volume of laboratory ambient air may be analyzed to serve as check for CO_2 and CH_4.
[7]Every analytical sequence must include a laboratory control sample. An LCS shall be analyzed at a rate of one per twenty samples or fewer for each analyte. The concentration of the LCS should be at the low end of the calibration curve as an indication that the system allows for good recovery at those concentrations.
[8]Modified EPA Method 25C requires a single injection for each sample.
[9]If performing EPA Method in accordance with this SOP, every batch must include the analysis of a laboratory duplicate. The samples selected for duplicate analysis shall be rotated among client samples, whenever possible.

11.3 Conditions

The column and detector temperatures should be adjusted to the recommended levels. The column should be conditioned as in 4.1.1. Once the GC/FID system is optimized for analytical separation and sensitivity, the identical sample operating conditions must be used to analyze all samples, blanks, calibration standards and quality assurance samples. Refer to Attachment B for the recommended operating conditions for the analytical system.

11.4 Retention Time Windows

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Retention time windows for each target analyte (except TGNMO) must be generated initially and whenever there is a major change in instrument conditions including flow rates. They must also be generated when standard analyses result in analyte retention times outside the established windows. The procedure for determining the retention time windows for this method is as follows. However, other approaches may be employed (using the ICAL standards), providing the analyst can demonstrate that they provide performance appropriate for the intended application.

1. Make sure that the system is operating reliably and that the system conditions have been optimized for the target analytes in the sample matrix to be analyzed.
2. Make four injections of all applicable standard mixes over a 72 hour period. Make the injections cover the entire 72-hour period or the end result could be windows which are too tight.
3. Record the retention time for each single component analyte to three decimal places. Calculate the mean and standard deviation of the four absolute retention times for each single component analyte and surrogate.
4. If the standard deviation of the retention times for the target compound is 0.000, then additional injections may be included or the use of a default standard deviation of 0.01 minutes.
5. The width of the retention time window for each analyte is defined as ±3 times the standard deviation of the mean absolute retention time established during the 72 hour period. If the default standard deviation of 0.01 is used, the width of the window will be 0.03 minutes.
6. Establish the center of the retention time window for each analyte by using the absolute retention time for each analyte from the continuing calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.
7. New retention time windows must be calculated for each analyte when a new column is installed.

11.5 Catalyst Efficiency Verification

The catalyst efficiency verification shall be performed during the initial set-up of the analytical system, after any shutdown of six months or more, and after any major modification to the system, or at the frequency recommended by the manufacturer.

11.5.1 Oxidation Catalyst Check

Under optimum conditions, greater than 99% of the non-methane organics compounds (NMOC) should be converted to carbon dioxide by the oxidation catalyst. If greater than 99% of the NMOC is converted to CO_2 the remaining NMOC should measure less than 1% on the flame ionization detector. The check of the oxidation catalyst must be conducted as follows:

1. Disconnect or bypass the oxidizer catalyst.
2. Switch the temperature control of the reducer to the off position and cool to ambient temperature.
3. Perform three consecutive injections of a 1000ppm standard of methane.
4. Calculate the average response of the three injections of the methane standard (M_b).

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5. Reconnect the oxidizer to the system and set the temperature of the oxidizer to 590°C. The reducer remains at ambient temperature.
6. Perform three consecutive injections of the 1000ppm methane standard and calculate the average response of the three injections (M_c).

The result of the following equation must be less than 1.0% in order for the oxidation catalyst check to be considered acceptable.

$$\frac{(M_c)\,(100)}{(M_b)}$$

where:

M_b is the average methane response (oxidizer bypassed).
M_c is the average oxidized methane response (oxidizer connected).

11.5.2 Reduction Catalyst Check

After successful completion of the oxidation catalyst check and with the oxidation catalyst unheated or bypassed and the heated reduction catalyst bypassed, make triplicate injection of a high level methane standard. Repeat this procedure with both catalysts operative.

The reduction catalyst operation is acceptable if the responses under both conditions agree within 5% of their average.

11.6 System Performance Check

The overall performance of the NMOC analyzer system must be evaluated every time a new catalyst is installed. However, this check should be performed annually since the purpose of the system performance check is to verify that the system is performing the catalytic conversion to CO_2 and then CH_4 quantitatively, regardless of the molecular weight(s) or chemical composition of the gas being analyzed.

Separate calibration gas standards are prepared in zero grade air (helium or nitrogen): 50ppm hexane, 20ppm toluene and 100ppm methanol in accordance with Section 9.6 of this document. Each standard gas must be injected in triplicate and the average response of the multiple injections calculated and the %RSD for each standard must be <2%. In addition, the measured NMOC value must be within 5% of the expected value.

Standard	Concentration	Expected NMOC Value	#CH_4 Molecules Generated
Toluene	20ppm	140ppmC	7
Hexane	50ppm	300ppmC	6
Methanol	100ppm	100ppmC	1

11.7 Analyzer Linearity Check and Initial Calibration

The initial calibration shall be performed to determine instrument sensitivity and the linearity of the GC response for the target compounds. The initial calibration is

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performed to determine instrument sensitivity and the linearity of the GC response for the target compounds. This check shall be performed initially, when check standards indicate a problem, and if the method has been changed or maintenance has been performed which may alter the sensitivity of the instrument.

Record each of the instrument parameters, sample loop volume utilized and component concentrations in the sample logbook. All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, each analyte name, analyst's initials, concentration and response, and response factor.

11.7.1 Analysis Guidelines

- The concentrations of the initial calibration standards must span the monitoring range of interest of the analytical system.
- Each of the injections shall be used in the calibration curve.
- Refer to Section 12.2 for the specific acceptance criteria.

11.7.2 Initial Calibration Requirements

Once a set of ICAL standards is analyzed and used to process samples, the previous ICAL may no longer be used and it must be archived. The only time an archived ICAL can be used thereafter is to review or re-evaluate samples(s) previously processed using that ICAL.

1. A minimum of 5 concentrations (single injection) must be used to calculate the calibration curve.
2. Highest concentration, together with the lowest concentration, defines the calibration curve.
3. Lowest concentration must be at or below the method reporting limit.
4. The initial calibration event may not be interrupted by maintenance.
5. Analyze calibration standards from low to high concentration.
6. All ICAL analyses must be completed within 48 hours.
7. For 5 points, 1 re-injection may be made. If analyzing 6 levels, 2 re-injections may be made to replace "bad" injections.
8. Point dropping policy:

    - There must be a minimum of five concentrations utilized to calculate the curve. The following are guidelines to follow if points are to be reviewed to determine the appropriateness of dropping a point or injection.
    - Lowest concentration must be at the MRL and may not be dropped unless another concentration is added to the upper end of the curve. This would in turn raise the MRL.
    - Points may not be dropped from the interior of the curve.
    - If a point or a calibration standard is dropped, the reason must be documented (and the results maintained with the documentation for the final ICAL).
    - A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 48 hours).

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- Once the ICAL has been used to calculate and report sample results, it is not to be changed.

11.7.3 ICAL Update Procedure

1. Open most recent method.
2. Save to new ICAL method ID. The date used in method ID is the date files were analyzed.
3. Clear all responses prior to update initiation and/or clear levels if different concentrations are to be used (Initial Calibration → Clear All Calibration Responses; Initial Calibration → Clear All Calibration Levels).
4. Quantitate standard
5. Review all peaks for retention time, integration, etc.
6. Update responses for standard
7. Repeat for all standards
8. If necessary load midpoint standard and update retention times.
9. Save method.
10. Verify Calibration Files listed on Response Factor Report are correct (Both Primary and Secondary Reviewer).
11. Verify responses of Page 3 of Edit Compounds are correct (Both Primary and Secondary Reviewer).
12. Verify file ID, acquisition time, quant time, update time, and last update information is correct on the Calibration Status Report (Both Primary and Secondary Reviewer).
13. Save Method. Confirm that no other copies of the method are open on other computer workstations.

Note: It is also acceptable to quantitate all standards and review all peaks before updating responses but steps 1-2 still must be completed initially. Step 3 also must be done prior to beginning ICAL update.

11.7.4 Initial Calibration Review

Analyst's calculation and assessment along with a peer review of all ICAL data and documentation as stated in Attachment D is required before the ICAL may be used to report samples.

11.7.5 Initial Calibration File

An ICAL file is to be created for each initial calibration performed into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- Blank analysis quantitation report
- Calibration status report (aka Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Quantitation report for each calibration standard (including manual integration documentation – appropriate before and after manual integration printouts)

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- ICV quantitation report and evaluate continuing calibration report (aka Percent Difference Report)

11.7.6 Initial Calibration Verification A quality control check standard is analyzed directly following the initial calibration. The ICV is used to assess the accuracy of the calibration standard analysis. Refer to Section 12.3 for the acceptance criteria.

11.8 Continuing Calibration

The CCV shall be analyzed by injecting a known volume of the standard prepared in Section 9.5.3. The calibration verification may be varied within the established calibration range.

11.9 Method Blanks

Method blanks (zero grade air or helium) shall be analyzed following the continuing calibration and before sample analysis. Method blank analysis must also be performed after highly concentrated samples to check for system contamination.

11.10 Analysis

Sample analysis must be made using the same instrument parameters as that of the calibration standards. Prior to analysis, submitted canister sample(s) shall be evaluated and pressurized in accordance with the requirements detailed in the *SOP for Evaluating and Pressurizing Specially Prepared Stainless Steel Canisters*.

Note: Refer to Heart-Cut Technique for procedures on the analysis of samples with heavy hydrocarbons or complex sample matrices.

Analysis shall proceed as follows:

1. Place the appropriate adapter on the sample container as needed to connect to the system.
2. Ready the data system, start pumps and wait ~10 seconds to evacuate dead volume.
3. Open valve on canister and wait ~10 seconds to purge the sample loop with sample and allow filling.
4. Inject sample, close the valve on the sample container *immediately* after hearing the injection valve switch.
5. Allow the GC to run for 8 minutes making sure that during the backflush cycle that the amplitude of the signal returns to the normal baseline at the conclusion of the run.
6. Upon completion of the run wait for the GC to return to "*ready*" status.

11.10.1 Heart-Cut Technique Samples that contain methane and/or carbon dioxide at concentrations greater than 0.5% shall be analyzed using the heart-cut technique that selectively vents methane and/or carbon dioxide while quantitatively retaining the entire NMOC portion of the sample. Refer to Section 5.3.1 for additional information on when this technique must be utilized.

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11.10.2 Sample Dilution If any target analyte results are above the highest level of the initial calibration, a smaller sample loop may be used. Guidance in performing dilutions and exceptions to this requirement are given below.

- Use results of the original analysis to determine the approximate dilution loop required to get the largest analyte peak within the initial calibration range.
- The dilution factor chosen should keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument. Additional compounds may be reported as long as they are within the calibration range or reported with the appropriate data qualifier.

11.10.3 Qualitative Analysis

- The analyte selected must fall within 0.33minutes of the mean ICAL RT (except TGNMO).
- The sample retention time for the analyte in question, except TGNMO, must be within the retention time window based on the RT in the CCV standard.

11.10.4 Quantitative Analysis

TGNMO-1 and TGNMO-2: Due to various peak shapes and uneven baselines, it may be more appropriate to split the TGNMO peak into two integrations. The resulting concentrations shall be added and reported accordingly.

11.11 Laboratory Control Sample

The laboratory control sample is an injection of the initial calibration verification standard and should approximate the concentration of the submitted samples. Make sure that all of the pertinent information is included on the quantitation report including the sample identification (LCS), concentration, standard used, and analyst. Refer to Section 12.7 for the acceptance criteria.

11.12 Laboratory Duplicate

The selected sample(s) shall be rotated among client samples, whenever possible. This is so that various matrix problems may be noted and/or addressed. Poor performance in the LD may indicate a problem with the sample composition. Refer to Section 12.5 for the acceptance criteria.

11.13 Manual Integration

The integration for each peak shall be evaluated by the analyst to ensure that it has been integrated properly. Assuming an incorrect automatic integration the analyst shall conduct the manual integration in accordance with the *SOP for Manual Integration Policy* including all documentation and reviews associated with the process. The review must include the analyst and reviewer providing an indication of acceptability and approval by initialing and dating the manual integration.

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11.14 Method Detection and Quantitation Limits

The MDL must be performed in accordance with the procedure outlined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* Method detection limits must be determined annually and each time there is a change in the test method that affects how the test is performed, or when a change in instrumentation is such that it affects the sensitivity of the analysis. The MDL study shall be performed on each instrument for which this method is performed.

11.15 Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files shall be saved in a unique sub-directory on the server. An example of how the analyst must store analytical data is as follows:

Instrument Number/Data/Method ID/yr_month/.d*

11.16 Loop Calibration Procedure

The loop injection port has two loops of different size to introduce sample to the instrument. The normal loop is 500µl and the smaller loop is calibrated against the normal loop for a known dilution factor for the smaller injection volume.

A standard of approximately 100ppm for all analytes is analyzed three times with the normal loop. The area counts for all analytes are summed for each standard. This summation is averaged of the three standard injections. This procedure is duplicated using the smaller loop. The dilution factor is the ratio of the average area counts of the normal loop divided by the average area counts of the smaller sampling loop.

12) Quality Assurance/Quality Control Requirements

12.1 This section of the standard operating procedure contains technical acceptance criteria per the guidelines of the specified test method. To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s) as detailed in Section 17 of this document.

12.2 Initial Calibration Acceptance Criteria

a) The percent relative standard deviation (%RSD) must be ≤15%.
b) All of the analytes must fall within the established retention time windows.
c) Each analyte shall be within 0.33 minutes of the ICAL mean retention time.

12.3 Initial Calibration Verification Standard (ICV) Acceptance Criteria

a) The calculated concentration for each compound in the ICV must be within ±15% of the actual concentration.

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12.4 Continuing Calibration Verification (CCV) Acceptance Criteria

a) The CCV must be ±15% of the component concentration.
b) Each analyte, except TGNMO, must be within the generated retention time window.
c) Each analyte (except TGNMO) must be within the 0.33min. of the average RT from the ICAL.

12.5 Laboratory Duplicates Acceptance Criteria

a) The RPD of the results for the two samples shall be within the generated control limits, where available. Otherwise the RPD shall be < or = to 20%. Refer to Attachment A.

Data points for generating control limits must be collected over many months to ensure that all variables associated with the analysis are captured. Limits may be generated by collecting points from the first week of every month. See the *SOP for Control Limits* for additional requirements.

b) The RT criteria stated in Section 12.6 below shall be followed.

12.6 Sample Analysis Acceptance Criteria

Sample results must be quantitated from the initial instrument calibration. Samples out of holding time must be handled according to Section 16.2. Refer to Section 17.3 for a statement regarding sample quality control criteria.

a) Each analyte, except that of the TGNMO peak, shall be within the generated retention time windows (using the CCV as the absolute RT).
b) Each analyte (except TGNMO) must be within the 0.33min of the average RT from the ICAL.

12.7 Laboratory Control Sample Acceptance Criteria

a) The percent recovery must be within the generated control limits, refer to Attachment A.

Data points for generating control limits must be collected over many months to ensure that all variables associated with the analysis are captured. Limits may be generated by collecting points from the first week of every month. See the *SOP for Control Limits* for additional requirements.

12.8 Method Blank Acceptance Criteria

a) All analytes must be below the method reporting limit.

13) Data Reduction and Reporting

13.1 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Method modification (modification of EPA Method 25C), sample ID code, date of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, all manual calculations including dilutions and

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manual integrations, analyst's initials, sample preparation (pressure readings and balance gas), standard and reagent origin, sample receipt, calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, interpretation, and assessment and reporting conventions.

13.2 Initial Calibration

13.2.1 Calculate the response factors for each injection (at each concentration) using equation number 2.
13.2.2 Calculate the %RSD using equation numbers 3, 4 and 5.

13.3 Initial Calibration Verification

13.3.1 Calculate the response factors using equation number 2.
13.3.2 Calculate the % RSD of the responses using equation numbers 3, 4 and 5.
13.3.3 Calculate the percent difference (%D) of the RF of the ICV compared to the mean RF in the initial calibration using equation number 7.

13.4 Continuing Calibration Verification

13.4.1 Calculate the percent difference (%D) in the concentration for each analyte between the calculated concentration and the actual concentration using equation number 7.

13.5 Laboratory Duplicate

13.5.1 Calculate the relative percent difference (RPD) using equation number 6.

13.6 Sample Analysis

All sample results must be quantified from the initial calibration and at no time shall the continuing calibration verification be used for this purpose.

13.6.1 Calculate dilution factors using equation number 8
13.6.2 Calculate the final concentrations utilizing all determined pressures and dilution factors for each analyte and use equation number 9.
13.6.3 For TGNMO add the calculated concentration for TGNMO-1 and TGNMO-2 and report accordingly.

13.7 Laboratory Control Sample

13.7.1 Calculate the percent recovery using equation number 1.

13.8 Calculations

13.8.1 Equation Number 1

Percent Recovery (%R):

$$\%R = \frac{C}{S} x100$$

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where
C = Concentration of the analyte recovered
S = Spiked amount

13.8.2 Equation Number 2

Response Factor (RF)

The response factor, for analyte *x* is given by:

$$RF = \frac{A_x}{C_x}$$

where:

A_x = Area of the analyte in the standard

C_x = Concentration of the analyte in the standard

13.8.3 Equation Number 3

Average (or Mean) RF

$$\overline{RF} = \frac{\sum_{i=1}^{N} RF_i}{N}$$

where:

RF_i are the individual RFs from each concentration level in the initial calibration curve.
N is the number of calibration concentration levels.

13.8.4 Equation Number 4

Standard Deviation, SD:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(RF_i - \overline{RF}\right)^2}{N-1}}$$

where:

RF_i are the individual RFs from each concentration level in the initial calibration curve.

$\overline{RF}$ Average (or Mean) RF of all concentration levels in the initial calibration curve.

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N total number of calibration concentration levels

13.8.5 Equation Number 5

Percent Relative Standard Deviation, %RSD:

$$\%RSD = \frac{SD}{\overline{RF}}(100)$$

where:

SD Standard Deviation calculated in equation number 3
$\overline{RF}$ Average or Mean RF

13.8.6 Equation Number 6

Relative Percent Difference (RPD)

$$\frac{|R_1 - R_2|}{\left(\frac{R_1 + R_2}{2}\right)} x100$$

where:

R_1 First measurement value
R_2 Second measurement value

13.8.7 Equation Number 7

Percent Difference, %D,

The %D is used for evaluating ICV and CCV vs. the initial calibration

$$\%D = \frac{C_{CCVorICV} - C_{std}}{C_{std}}(100)$$

where, for any given analyte:

$C_{CCVorICV}$ is the concentration being evaluated.
C_{std} is the concentration from the current calibration curve.

13.8.8 Equation Number 8

Dilution Factor

$$DF = \frac{14.7 + P_f}{P_i + 14.7}$$

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where:

DF Dilution factor, psia
P_f Final pressure
P_i Initial pressure

13.8.9 Equation Number 9

Concentration (C):

$$C = \frac{Area}{\overline{RF}} \times DF \text{ (see eq. 8)}$$

where:

Area is the area obtained from the chromatogram.
$\overline{RF}$ Average (or Mean) RF of all concentration levels in the ICAL.

13.9 Review and Reporting

The analyst shall review the analysis data and a secondary qualified analyst will perform a peer-review. The data review checklist is used to document these reviews (Attachment E).

The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results and all information required by the *SOP for Data Review and Reporting* as well as this SOP.

13.10 Sample Preparation and Analysis Observations / Case Narrative Summary Form

This form, which is included in the *SOP for Laboratory Storage, Analysis, and Tracking*, must be generated when there are specific sample composition information or analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are preserved.

This form is necessary as a means for documentation. This form, among other information, will be reviewed when compiling the final report and case narrative. All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through analysis, data reduction, and reporting.

14) Method Performance

14.1 Method performance is evaluated daily by monitoring the recoveries of the laboratory control sample for accuracy, and duplicate injections for precision. In addition method detection limit studies are performed annually. See Attachment A for Method Detection Limits and Method Reporting Limits.

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15) Pollution Prevention and Waste Management

15.1 All waste management must be carried out in accordance with the requirements detailed in the *SOP for Waste Disposal* as well as the Environmental Health and Safety Manual.

16) Corrective Action for Out-of-Control Data

16.1 It must be determined if there are any instrumentation problems contributing to the result of any out of control data. If it is decided that problems do exist then the analyst must determine if the effects have caused any modification in the data. This being the case, all samples (including QC) that are affected by instrumentation problems must be re-analyzed following any necessary maintenance activity. Corrective actions unless otherwise noted shall follow the documentation procedures outlined in the *SOP for Nonconformance and Corrective Action*

16.2 Sample's Holding Time Expired

The client must be notified (best attempt) that the sample's holding time was missed and the client is to decide if the sample analysis shall continue. The documentation of missed holding time and the client's decision to proceed must be included in the corresponding job file. A statement or appropriate data qualifier(s) dictating all holding time occurrences must accompany the sample results in the final report.

16.3 Initial Calibration

If the %RSD is not acceptable for any point on the curve, check standards for a bad injection and reanalyze the appropriate number of injections or drop a point in accordance with the guidelines listed in Section 11.7.2. In addition, it may be necessary to perform maintenance to meet the ICAL technical acceptance criteria. If a bad injection is not evident, perform maintenance and attempt another initial calibration (make notation in maintenance logbook regarding any steps taken). If the recalibration does not meet the established criteria, new calibration standards may need to be made.

A demonstration of an in-control system is required before proceeding with the analysis.

16.4 Initial Calibration Verification Standard (ICV)

If the acceptance criterion for the ICV is not met, the standard must be reanalyzed and reevaluated. If reanalysis also fails to produce an acceptable recovery, a new standard should be prepared and analyzed. If this is unsuccessful, the initial calibration should be reassessed for possible problems. It may be necessary for new calibration standards to be prepared and analyzed.

16.5 Continuing Calibration Verification (CCV)

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If the calibration fails to meet these expected criteria, the CCV may be reanalyzed. It may be necessary to perform maintenance prior to reanalysis. If routine maintenance does not correct the problem, the instrument must be recalibrated.

However, if any corrective action and/or reanalysis fails to produce continuing calibration verification within acceptance criteria (analyzed immediately following the initial failure), then either a successful verification must be performed following corrective action or a new initial calibration must be performed. However, sample data associated with an unacceptable calibration verification may be reported as qualified data under the following special condition:

> *When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise the sample affected by the unacceptable CCV shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.*

If the analytes do not fall within the generated windows, new retention time windows should be generated.

16.6 Laboratory Duplicates

If the RPD fails, repeat analysis in order to eliminate any possible injection errors. If the acceptance criterion is still not met then evaluate the chromatograms for any matrix effect.

Refer to Section 16.7 for corrective action when RT criteria are not met.

16.7 Sample Analysis

If analytes (except TGNMO) are not within generated retention time windows (using the CCV as the absolute RT), repeat analysis in order to eliminate any possible injection error. If the acceptance criteria are still not met then evaluate the chromatograms for any matrix effect.

If analytes (except TGNMO) are not within 0.33min of the average RT from the ICAL, a continuing calibration standard may be analyzed to evaluate the retention times and the target analytes identified and reported accordingly.

16.8 Laboratory Control Sample

Reanalyze the LCS and if the results still do not meet the control limits analyze another continuing calibration standard. If the CCV is within the acceptance criteria a new second source standard should be prepared and analyzed.

16.9 Method Blank

If the analyte results in the blank do not meet the acceptance criteria the source of the problem must be investigated and measures taken to eliminate the source. Determine whether the contamination is from the instrument, carrier gas or etc. Regardless,

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appropriate corrective measures must be taken and documented before further sample analysis proceeds.

17) Contingencies for Handling Out-of-Control or Unacceptable Data

17.1 To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s) as detailed in the most current Quality Assurance Manual.

17.2 When analysis quality control results (CCV, MB, LD, and LCS) are out-of-control:

If the associated samples are within holding time, re-analyze the sample with criteria under control. Alternatively, evaluate the effect on the sample results and report the results with qualifiers and/or discuss in the case narrative if the effect is judged insignificant.

17.2.1 ICAL and ICV No data shall be reported with an out of control initial calibration curve and/or initial calibration verification

17.2.2 CCV Refer to Section 16.5 for specific information on reporting any results associated with an out of control CCV.

17.2.3 Method Blank If an analyte in the blank is found to be out of control and the analyte is also found in associated samples, those sample results shall be "flagged" in the report. If the analyte is found in the blank but not in the sample and all other quality control meets acceptance criteria then the results for the sample may be reported without a qualifier. However, if other QC is out of control then an evaluation must be made and the results reported accordingly.

17.2.4 Laboratory Control Sample Since the laboratory control sample, in the case of this method is the ICV, the results for the out of control LCS shall only be reported at the client's request. However, the data from the LCS shall be retained on file and the continuing calibration must be in control in order to report any data.

17.2.5 Laboratory Duplicate (Analysis with Modification) If the results from any of the repeated injections are still unacceptable and there does not appear to be any matrix effects, interfering peaks, or instrument problems, the results for each injection shall be reported to the client. If the out-of-control results are due to matrix interferences, report the results with a matrix interference qualifier.

17.3 Sample Out of Control

17.3.1 Hold Time All Tedlar bag samples analyzed outside of the required hold time of 72 hours must be reported with the appropriate qualifier.

18) Training

18.1 Training shall be conducted in accordance with the *SOP for Training Policy*. This information shall be documented using Attachment C and retained on file for all

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personnel responsible for performing this method. Initial demonstration of proficiency shall be performed using the result from the analysis of four laboratory control samples, with acceptable results.

19) Method Modifications

19.1 Initial calibration modification The method for EPA25C specifies a calibration curve of three points analyzed in triplicate for a total of nine points utilizing the average response factor. The modification in this SOP is to follow the laboratory's policy for calibration curves. (see section 11.7 and 12.2 for details)

19.2 Sample Analysis EPA25C has triplicate injections for all standards, blanks and samples. This modification uses a single injection.

19.3 Sample Calculation EPA25C uses the response factor for the daily standard analyzed in triplicate to calculate sample concentrations. In this modification the initial calibration's average response factor is used to calculate sample concentrations.

20) Summary of Changes

20.1 SOP updated using ALS SOP Template – New cover page, document tracking/signature page, and table of contents page. Header/footer and font revised throughout SOP to align with ALS SOP template specifications. Sections reorganized as outlined in the *SOP for Establishing Standard Operating Procedures* and section references updated as necessary. Section titled "Instrument Specific Addendum" removed (Previously Section 21). Information previously in this section moved to Section 11.16.

Section 1	Renamed section heading "Scope and Applicability"
Section 2	Renamed section heading "Summary of Procedure"
Section 4	Was Section 10 in previous revision
Section 4.1	Updated SOP title
Section 5	Was Section 4 in previous revision
Section 6	Was Section 5 in previous revision
Section 7	Was Section 6 in previous revision
Section 8	Was Section 7 in previous revision
Section 9	Was Section 8 in previous revision
Section 10	Was Section 9 in previous revision
Section 11	Moved section titled "Sample Preparation and Analysis Observations / Case Narrative Summary Form" to Section 13.10
Section 11.1	Removed reference to SOP referenced later in Section 11
Section 11.7.2	Revised first sentence
Section 11.7.3	Added section and renumbered following sections
Section 11.13	Updated SOP title
Section 16.1	Updated SOP title
Section 18	Was Section 19 in previous revision Renamed section heading "Training"
Section 18.1	Updated SOP title
Section 19	Was Section 20 in previous revision
Section 19.1	Updated "CAS" to "the laboratory's"
Section 20	Was Section 22 in previous revision Renamed section heading "Summary of Changes"

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Section 21	Was Section 18 in previous revision
Section 21.1	Corrected SOP code
Section 21.4	Updated SOP title and ID
Section 21.5	Updated SOP title and ID
Section 21.8	Updated SOP ID
Section 21.10	Updated SOP title and ID
Section 22	Was Section 23 in previous revision
Attachment A	Updated MDL values
Attachment C	Removed information at top of checklist covered in SOP header #4 – updated 2nd, 3rd, and 5th SOP titles
Attachment D	#10 – updated "CAS" to "laboratory's" #15 – updated SOP title
Attachment E	Removed "CAS" from "Project #" Added LIMS approval boxes

21) References

21.1 *SOP for Data Review and Reporting,* SOP Code ADM-DATA_REV

21.2 *SOP for Waste Disposal,* SOP Code DSP-Waste

21.3 *SOP for Batches and Sequences*, SOP Code ADM-BATCH_SEQ

21.4 *SOP for Making Entries Onto Analytical Records,* SOP ID CE-QA007

21.5 *SOP for Training Policy,* SOP ID CE-QA003

21.6 *SOP for Manual Integration Policy,* SOP ID CE-QA002

21.7 *SOP for the Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation,* SOP Code ADM-MDL

21.8 *SOP for Control Limits,* SOP ID CE-QA009

21.9 *SOP for Handling Consumable Materials,* SOP Code ADM-CONSUM

21.10 *SOP for Nonconformance and Corrective Action,* SOP ID CE-QA008

21.11 *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters,* SOP Code SMO-Can-Press

21.12 *SOP for Evaluation Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters,* SOP Code SMO-CanCert

21.13 EPA Method 25C, Determination of Non-Methane Organic Compounds (NMOC) in Landfill Gases.

21.14 EPA Method 25, Determination of Total Gaseous Non-Methane Organic Emissions as Carbon, EPA Stationary Source Test Methods.

22) Attachments

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22.1 Attachments

Attachment A: MDLs, MRLs and Control Limits
Attachment B: Instrument Conditions
Attachment C: Training Plan for Analysis of Modified EPA Method 25C
Attachment D: Initial Calibration Checklist for Modified EPA Method 25C
Attachment E: Data Review Checklist for Modified EPA Method 25C

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Attachment A

MDLs, MRLs, and Control Limits

METHOD DETECTION AND REPORTING LIMITS

ANALYTE	MDL	MRL
Carbon Monoxide	0.77ppm	5.0ppm
Methane	0.19ppm	0.5ppm
Carbon Dioxide	0.90ppm	5.0ppm
TGNMO	0.84ppm	1.0ppm

Note: The method detection limits and/or the method reporting limits for the compounds listed above may change with each new MDL study performed.

CONTROL LIMITS

Analyte	LCS - LCL (%R)	LCS - UCL (%R)	LD (RPD)
CO	73	132	15
CH_4	75	132	14
CO_2	71	123	15
TGNMO	71	136	14

Note: Refer to the most recent control limits established as these may change following the revision of this document.

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Attachment B

Instrumental Parameters

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GC/FID Operating Conditions for TGNMO Analysis

Injection:	
Injector Type	Loop
Injection Volume:	500µL
Detector:	
Type	FID
Temperature	280°C
Gas Flow Rates:	
H_2 Flow Rate:	approx. 40 mL/min
Air Flow Rate:	approx. 400 mL/min
Makeup Gas:	Nitrogen
Makeup Gas Flow Rate:	approx. 40 mL/min
Carrier Gas:	Helium
Carrier Gas Flow Rate:	~25mL/min
Column (or equivalent):	
Type	packed
Phase	60/80-mesh Tenax/Haysep Q/Carbosphere
Specification	4' x 1/8" stainless steel
Temperature Program:	
Initial:	50°C for 2min
Ramp 1:	30°C/min to
Ramp 2:	200°C for 1min

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Attachment C

Training Plan for Analysis of Modified EPA Method 25C

Training Plan for Modified EPA Method 25C

Trainee _____ Trainer _____ Instrument _____

1. Read SOP Trainer ___ Trainee ___ Date _____
2. Read Methods: EPA 25 and 25C Trainer ___ Trainee ___ Date _____
3. Demonstrated understanding of the scientific basis of the analysis
   Gas chromatography Flame Ionization Trainer ___ Trainee ___ Date _____
   Total Combustion Analysis
4. Demonstrated familiarity with related SOPs Trainer ___ Trainee ___ Date _____
   SOP for Batches and Sequences
   SOP for Making Entries Onto Analytical Records
   SOP for Manual Integration Policy
   SOP for Significant Figures
   SOP for Nonconformance and Corrective Action
   SOP for Performing MDL Studies and Establishing Limits of Detection and Quantitation
5. Observe performance of SOP Trainer ___ Trainee ___ Date _____
   ___analytical sequence setup
   ___catalyst efficiency verification
   ___system performance check
   ___standard preparation
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis including heart-cut technique
   ___EnviroQuant introduction
   ___data reduction and reporting
6. Perform SOP with supervision Trainer ___ Trainee ___ Date _____
   ___analytical sequence setup
   ___catalyst efficiency verification
   ___system performance check
   ___standard preparation
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis including heart-cut technique
   ___EnviroQuant use
   ___data reduction and reporting
7. Independent performance of the SOP Trainer ___ Trainee ___ Date _____
   ___analytical sequence setup
   ___catalyst efficiency verification
   ___system performance check
   ___standard preparation
   ___initial calibration and initial calibration verification
   ___continuing calibration verification
   ___sample analysis including heart-cut technique
   ___EnviroQuant proficiency
   ___data reduction and reporting
   ___initial demonstration of competency (Selection at the discretion of the QA Manager)
      ___ Four consecutive laboratory control samples; or
8. Instrument operation and maintenance Trainer ___ Trainee ___ Date _____
   ___gas chromatograph and column installation (packed)
   ___detector (FID) setup and maintenance
   ___Total Combustion Analyzer – catalyst preparation
   ___data system

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Attachment D

Initial Calibration Checklist for Modified EPA Method 25C

ICAL Date _____
Instrument _____

EPA Method 25C Modified
Initial Calibration Checklist

Analyst **Reviewer**

☐ 1. Is the required documentation in the ICAL file? ☐
- ☐ Sequence report ☐
- ☐ Blank analysis Quantitation Report ☐
- ☐ Calibration Status Report (aka Calibration History) – Initial ☐
- ☐ Response Factor Report ☐
- ☐ Quantitation Report for each calibration standard (including manual integration documentation – before and after printouts) ☐
- ☐ ICV Quantitation Report and Evaluate Continuing Calibration Report (aka Percent Diff. report) ☐

ICAL Analysis Requirements

☐ 2. Was the ICAL performed continuously (i.e., not interrupted for maintenance or sample analysis)? ☐

☐ 3. Was the ICAL performed within 48 hours? ☐

☐ 4. Were the standards analyzed from low concentration to high concentration? ☐

☐ 5. Does each analyte's ICAL include a minimum of 5 concentrations? ☐

☐ 6. For each analyte, is the lowest standard's concentration at or below the MRL? ☐

☐ 7. For each analyte, does the ICAL include 5 consecutive levels? ☐

☐ 8. For each analyte, are there no levels skipped? ☐

☐ 9. If a point is dropped or a re-injection made, is information noted in the ICAL explaining the reason? ☐

☐ 10. Does this follow the laboratory's point dropping policy (including re-analysis within 48 hrs)? ☐

☐ 11. Is the %RSD ≤15%? ☐

☐ 12. Do all of the analytes fall within the established retention time window? ☐

☐ 13. Are all the analytes in the blank analysis < MRL? ☐

☐ 14. For the ICV analysis, is the percent recovery for each analyte 85-115%? ☐

☐ 15. Are all peak integrations including manual integrations (per *SOP for Manual Integration Policy*) acceptable? ***If so, initial and date the appropriate pages.*** ☐

COMMENTS:

_____

_____

_____

Analyst _____ Secondary Reviewer _____

Date _____ Date _____

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Attachment E

Data Review Checklist for Modified EPA Method 2C

EPA Method 25C Modified
Data Review Checklist

Analysis Date _____ Instrument _____
Client _____ QC level _____
Project # _____ Due Date _____

Analyst **Reviewer**

Initial Calibration

☐ 1. Referenced ICAL the most recent ICAL performed? ..... N/A
2. Referenced ICAL peer reviewed and all associated documentation including the ICAL review checklist available for review? ..... N/A
3. All associated requirements within the specified limits? ..... N/A

Continuing Calibration

☐ 4. All CCV raw data submitted? ..... ☐
☐ 5. Was the %D for the CCVs ≤15%? ..... ☐
☐ 6. Was a CCV analyzed at the beginning of the sequence, every 10 samples and the end of the sequence? ..... ☐

Sample Data

☐ 7. Is all sample data present and correct? ..... ☐
___Sample raw data?
___All target analyte responses within calibration range?
___All peak integrations acceptable?
___All manual integrations flagged and properly documented? Is so, initial and date.
___All retentions times within the generated retention time windows?
___All calculations correct?
___First quantitation report initialed and dated by analyst?
☐ 8. Are there no more than 20 samples analyzed in the sequence (including dilutions and LD)? ☐

QC Data

☐ 9. Duplicate sample analyzed 1 per 20 or fewer samples? ..... ☐
☐ 10. Is the PRD for the lab dup within the lab generated limits (if no limits then ≤20%)? ..... ☐
☐ 11. All the analytes in the MB ≤MRL? If not make notation on the spreadsheet and Case Narrative Summary Form. ..... ☐
☐ 12. Are all of the analyte recoveries within the control limits for the LCS? ..... ☐

COMMENTS:

_____
_____
_____
_____
_____

☐ LIMS Run Approval ☐ LIMS Supervisor Approval

Analyst _____ Secondary Reviewer _____

Date _____ Date _____

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SOP for VOCs Collected in Canisters and Analyzed by USEPA TO-15

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DOCUMENT TITLE:	*DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)*
REFERENCED METHOD:	*EPA TO-15*
SOP ID:	*VOA-TO15*
REV. NUMBER:	*20.0*
EFFECTIVE DATE:	*01/07/2013*

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DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

EPA TO-15

SOPID:	VOA-TO15	Rev. Number:	20.0	Effective Date:	01/07/2013

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DETERMINATION OF VOLATILE ORGANIC COMPOUNDS IN AIR SAMPLES COLLECTED IN SPECIALLY PREPARED CANISTERS AND GAS COLLECTION BAGS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

1) Scope and Applicability

1.1 This procedure is based on and incorporates the requirements detailed in EPA Compendium Methods TO-15 and TO-14A and is used to quantify a wide range of volatile organic compounds (VOCs) in gaseous matrices collected in gas collection bags (method modification) and specially prepared stainless steel canisters. This method typically applies to ambient concentrations of VOCs 0.50ug/m^3 (down to 0.10ug/m3 for low level ambient analyses) and above for the SCAN mode and 0.010ug/m^3 and above for the SIM mode; however, refer to Tables 3 and 3A for the specific laboratory initial calibration ranges for each target compound. The method requires VOC enrichment by concentrating up to one liter of a sample volume, with a virtually unlimited upper concentration range using dilutions from source level samples.

In this document, Tables 2 and 2A (see Note 1 below) list compounds that can be determined by this procedure along with their corresponding laboratory method reporting limits (MRLs) and method detection limits (MDLs). The reported MRL may be adjusted higher; however, the capability of achieving lower MRLs for specific project requirements must be thoroughly demonstrated (by an acceptable initial calibration and method reporting limit check standard) and documented as long as the MRL is higher than the current method detection limit for each compound. Additional compounds may be analyzed according to this procedure as described in the referenced methods as long as the requirements of this document are adhered to; however, if a compound is not listed in the TO-15 method, refer to Note 1 below. The number of samples that may be analyzed in a 24-hour period is about twenty. The number of sample results that may be reduced in an eight-hour day is approximately twenty.

Note 1: A number of compounds selected as target analytes are not included in the TO-15 Method; therefore the Florida Department of Health (FL DOH) required the laboratory to reference this Standard Operating Procedure (SOP) when reporting results for these analytes. However, the FL DOH disapproved of the SOP Code for this purpose, so CASS TO-15/GC-MS shall be referenced. Consequently, VOA-TO15 is otherwise known as CASS TO-15/GC-MS and shall be referenced, where necessary (on quantitation reports).

2) Summary of Procedure

2.1 The analytical method involves using a high-resolution gas chromatograph (GC) coupled to a mass spectrometer (MS). The GC/MS utilizes a linear quadrupole system, which allows for it to be operated by either continuously scanning a wide range of mass to charge ratios (SCAN mode) or by Select Ion Monitoring mode (SIM), which consists of monitoring a small number of ions from a specified compound list.

An aliquot of an air sample is concentrated on a solid adsorbent trap (either cryogenically or fan cooled glass beads or stronger adsorbents at higher temperatures) to collect the analytes of interest. To remove co-collected water vapor, the concentrated sample then goes through a water removal (dry purge) step. After the sample is pre-concentrated on a trap, the trap is heated and the VOCs are thermally desorbed onto a

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refocusing cold trap. The VOCs are then thermally desorbed onto the head of a capillary column once the cold trap is heated. The oven temperature (programmed) increases and the VOCs elute and are detected by the mass spectrometer.

Mass spectra for individual peaks in the total ion chromatogram are examined with respect to the fragmentation pattern of ions corresponding to various VOCs including the intensity of primary and secondary ions. The fragmentation pattern is compared with stored spectra taken under similar conditions, in order to identify the compound. For any given compound, the intensity of the primary fragment is compared with the system response to the primary fragment for known amounts of the compound. This method utilizes the internal standard calibration technique; refer to Section 3.16 for a complete definition.

3) Definitions

3.1 Cryogen A refrigerant used to obtain sub-ambient temperatures in the VOC concentrator and/or on front of the analytical column. Liquid nitrogen (cryogen) is used for this purpose and it has a boiling point of -195.8°C.

3.2 Gauge Pressure Pressure measure with reference to the surrounding atmospheric (barometric) pressure, usually expressed in units of psig. Zero gauge pressure is equal to atmospheric pressure.

3.3 MS-SCAN Mass spectrometric mode of operation in which the gas chromatograph (GC) is coupled to a mass spectrometer (MS) programmed to SCAN all ions repeatedly over a specified mass range.

3.4 MS-SIM Mass spectrometric mode of operation in which the GC is coupled to a MS that is programmed to scan a selected number of ions repeatedly [i.e., selected ion monitoring (SIM) mode].

3.5 Analytical Sequence The analytical sequence describes exactly how the field and QC samples in an analytical batch are to be analyzed.

3.6 Neat Stock Standard A purchased, single component assayed reference material having a stated purity used to prepare working calibration standards.

3.7 Stock Standards Solution A concentrated solution of one or more target analytes at a known concentration purchased from a reputable commercial vendor. Stock standard solutions are used to prepare working calibration standards.

3.8 Intermediate Calibration Standard A solution of one or more target analytes at a known concentration prepared either from one or more neat stock standards or from one or more stock standards solutions.

3.9 Working Calibration Standard A solution of all the target analytes at a known concentration prepared either from one or more intermediate calibration standards and/or from one or more stock standard solutions.

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3.10 Calibration or Standard Curve A calibration or standard curve is a graph which plots the concentration of a compound (or an analyte) versus the instrument response to the compound.

3.11 Initial Calibration Verification (ICV) Standard A solution prepared in the laboratory containing known concentration(s) of analytes of interest. The solution is prepared from neat stock standards and/or stock standards solutions which are from a different source than the standards used to prepare the working calibration standards.

3.12 Continuing Calibration Verification (CCV) Standard A working calibration standard which is analyzed at specific intervals in order to verify that the instrument continues to meet the calibration criteria.

3.13 Field Sample A sample collected and delivered to the laboratory for analysis.

3.14 Manual Integration This term applies to a data file in which setpoints have been changed and reintegration has occurred under the changed setpoints; baselines have been adjusted; peak integration start and stop "ticks" have been changed; peak area, or peak height, are changed after the time of data collection and data file generation.

3.15 Batch Quality Control (QC) Batch QC refers to the QC samples that are analyzed in an analytical batch of field samples and includes the Method Blank (MB), Laboratory Control Sample (LCS) and Laboratory Duplicate (LD).

3.16 Internal Standard Calibration Compares the instrument responses from the target compound in the sample to the responses of specific standards (called internal standards), which are added to the sample or sample preparation prior to analysis. The ratio of the peak area (or height) of the target compound in the sample or sample preparation is compared to a similar ratio derived for each calibration standard.

3.17 May This action, activity, or procedural step is neither required nor prohibited.

3.18 Must This action, activity, or procedural step is required.

3.19 Shall This action, activity, or procedural step is required.

3.20 Should This action, activity, or procedural step is suggested, but not required.

3.21 SOP Standard Operating Procedure

3.22 Service Request A form generated, at the time of sample receipt, which details pertinent information such as client name, address, contact, client and laboratory sample identifications, sampling and receipt dates and times, requested analyses, sample type, canister pressures (initial and final), and the service request number (unique number for each submitted job) and serves as an inter-laboratory "custody" form which accompanies all samples throughout the laboratory.

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3.23 Selectivity Selectivity of a method refers to the extent to which it can determine particular analyte(s) in a complex mixture without interference from other components in a mixture. Another definition is the extent to which a particular method can be used to determine analytes under given conditions in the presence of other components of similar behavior.

3.24 Limit of Detection (LOD) The smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%. (DoD Clarification). For consistency purposes, the LOD may be referred to as the MDL once it is reported; however, full verification will be on file in the laboratory per the procedures detailed in this document.

3.25 Limit of Quantitation (LOQ) The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard. (DoD Clarification). For consistency purposes and since the LOQ and MRL are equivalent with regards to laboratory procedure, the LOQ will be referred to as the MRL in this document and once it is reported. Full verification will be on file in the laboratory per the procedures detailed in the document.

3.26 Detection Limit (DL) / Method Detection Limit (MDL) The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type 1 error) is 1%. (DoD Clarification). For consistency purposes, the DL may be referred to as MDL. Also, as far as reporting is concerned the MDL will be raised up (where necessary) to the verified LOD per the procedures defined in this document and reported accordingly.

4) Responsibilities

4.1 It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP may perform analysis, interpretation and peer review of the results. Data reduction and/or peer review may be performed by another qualified employee. This employee must be familiar with the analytical technique and have completed a data review training plan to ensure familiarity with specific analysis and requirements.

The supervisor/manager must also ensure that method proficiency is documented initially and whenever significant changes in the instrument type, personnel, and matrix or test method are made. The department supervisor/manager or designee shall perform final review and sign-off of the data.

5) Interferences

5.1 Summa Canisters

Canisters shall be stored in a contaminant free location and shall be capped tightly during shipment to prevent leakage and minimize any compromise of the sample. The pressure/vacuum is checked prior to shipment and upon receipt from the field. Any problems with the sample from the field are noted and the Project Manager contacted.

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Also, canisters must be cleaned and certified to be free from target analytes before being shipped to the field for sample collection. The procedure is described in detail in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters* (refer to this procedure as well as Section 12.5 for the acceptance criteria).

Current laboratory practice entails the segregation of 6L canisters into ambient (low) level and source levels. All the ambient canisters are used for low level (indoor air, ambient air) projects and not intentionally for soil gas, SVE monitoring, or other higher level applications. It may be necessary to "retire" an ambient canister and re-assign for source level use if high concentrations are encountered. This decision will be made by management based on analytical concentrations and what compounds were encountered at these levels. If the level of any analyte is detected above 5,000ug/m*3* in the ambient can, then the supervisor/team leader must be contacted to determine if the canister(s) is to be retired. If retirement is decided upon, make a notation on the sample tag (or other color coded tag) of each canister in question. The notation must contain the analyte, threshold levels and retirement from ambient use (initial and date notation) so that the canister conditioning/management department may properly execute the retirement.

5.2 Analytical System

The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified zero air blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with buna-N rubber components must be avoided.

5.3 Carbon Dioxide

Excessive levels of carbon dioxide present in a sample may interfere with analysis by freezing up the cryogenic trap. A smaller aliquot must be analyzed to eliminate this problem, or the sample should be analyzed using the higher temperature multi-adsorbent trapping technique which allows carbon dioxide to pass.

5.4 Gas Collection Bags

This procedure covers the use of gas collection vessels such as Tedlar® or Mylar® bags. However, due to the nature of these types of bags it is not recommended that clients use this option for ambient air samples. Sample collection bags made out of ®Tedlar have contaminants that are inherent to the manufacturing process. The two main contaminants are phenol and N,N-Dimethylacetamide. However, this only becomes a problem when the concentration levels in the sample are low ppbv such as ambient air monitoring samples where more of the sample usually has to be concentrated and analyzed. To minimize the loss of sample integrity, a 72-hour hold time has been incorporated into the procedure.

5.5 Glassware

Interferences caused by contaminants in solvents, reagents, glassware, and other sample processing hardware results in discrete artifacts and/or elevated baselines in the detector profiles should be minimized. All glassware associated with this method must be scrupulously cleaned to avoid possible contamination. The cleaning shall be

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performed in accordance with the procedure outlined in the *SOP for Glassware Cleaning.* The use of high purity water, reagents, and solvents helps to minimize these problems.

6) Safety

6.1 Each compound, mixture of compounds, standards, and surrogates, as well as samples, should be treated as a potential health hazard. Exposure to these chemicals should be reduced to the lowest level possible through the use of gloves (to minimize absorption through the skin) and hoods (to minimize inhalation). Refer to the laboratory's Environmental, Health and Safety Manual as it makes reference to the safe handling of chemicals, MSDS location, and the laboratory waste management plan for the safe disposal of chemicals and samples.

6.2 Material Safety Data Sheets (MSDS)

The analyst should consult MSDS for compounds being handled in the course of this procedure, and be familiar with proper safety precautions to be followed when handling hazardous chemicals. Care should be taken when handling standard material in a neat or highly concentrated form.

6.3 Liquid Nitrogen

Liquid nitrogen can cause serious tissue damage (frostbite) with only a few seconds of contact. The valves on the cryogen dewars should be opened slowly so leaky fittings can be identified. Neoprene or leather gloves should be worn when turning valves and handling tubing and fittings that have been in contact with the cryogen.

6.4 Protective Clothing

Personal protective clothing (safety glasses, gloves and lab coat) are required when preparing standards and handling standard material in neat form.

6.5 Pressurized Gases

The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp when not in use. The regulator should never remain on small "D" size cylinders following use. Sources of flammable gases (i.e. pressurized hydrogen) should be clearly labeled.

6.6 Syringes

The proper use of syringes should be part of employee training for this SOP. Care should be taken to avoid personal injury as a result or improper handling techniques.

7) Sample Collection, Containers, Preservation, and Storage

7.1 Air samples are collected in the field and delivered to the laboratory and shall be collected in either a specially prepared, leak-free, stainless steel pressure vessel (with valve) of desired volume (e.g., 6L) or a sample collection bag (Tedlar). Canister samples may either be grab or time integrated (using a variable flow controller, refer to the *SOP*

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for Flow Controllers and Critical Orifices) utilizing the canister vacuum to draw the sample. Bags require the use of an upstream pump or a "lung machine."

7.2 There are no special preservation requirements for either canisters or bags. However, bags should be stored in an environment free from puncture or deterioration sources (by hanging them from clips), labeled with the specific service request number, in accordance with the *SOP for Laboratory Storage, Analysis and Tracking*. Canisters should be stored on the appropriate shelves until they are to be analyzed.

7.3 Sample collection bags must be analyzed within 72 hours from the confirmed time of sampling. Samples received by the laboratory shall be analyzed within 30 days of sampling or sooner if project specific requirements dictate. Programs, which have shorter recommended or required hold times, include the Department of Toxic Substances Control (DTSC), which advises a 72 hour hold time. The Minnesota Pollutions Control Agency (MPCA) and EPA Region 9 both require a 14 days hold time. Additionally, the MPCA does not allow the use of Tedlar bags for sampling or sample dilution. The DTSC requirement is an advisory notice, but the laboratory shall make every effort to comply. However, the following statement shall be added to each report where sample analyses do not meet the 72 hour hold time and the client project is intended to comply with DTSC requirements. *"The recommended 72-hour hold time for the analysis of TO-15 was exceeded per the DTSC and LARWQCB Advisory – Active Soil Gas Investigations document dated January 28, 2003; however, this specific hold time statement is advisory and not considered as regulation. In addition, the samples were analyzed within the EPA Method TO-15 stated requirement of 30 days."*

8) Apparatus and Equipment

8.1 Additional instruments and/or differing models may be utilized as long as they are equivalent and meet the minimum requirements of this document.

8.2 Gas Chromatograph (GC)

An instrument capable of temperature programming, with a column oven that may be cooled to sub-ambient temperature at the start of the gas chromatographic run to result in the resolution of the VOCs.

Hewlett Packard 5890 Series II Plus
Hewlett Packard 6890 Series
Hewlett Packard 6890A Series
Agilent 6890N Series
Agilent 7890A Series

8.3 Autosampler

Tekmar-Dohrmann AUTOCan Autosampler:	14-ACAN-074
Concentrating Trap (cryogenic trap, built-in):	14-6938-020
Cryofocusing Module w/split valve:	14-6520-A00
GAST Vacuum Pump:	DOA-P104-AA or equivalent

8.4 Mass Spectrometer (MS)

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A MS capable of scanning from 34 to 350 amu every second or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for Bromofluorobenzene (BFB) which meets all of the criteria when 50ng or less of BFB is injected onto the GC/MS system.

Hewlett Packard 5972 Series
Hewlett Packard 5973 Series
Agilent 5973N
Agilent 5973 *inert*
Agilent 5975B *inert*
Agilent 5975C *inert*

8.4.1 Ionization Gauge Controller

- Agilent: 59864B
- Granville-Phillips 330 Ionization Gauge Controller: 330001/2/3
- Hewlett Packard Ionization Gauge Controller: 59864B

8.5 Analytical Column

Any analytical column capable of separating the compounds of interest may be used. The capillary column should be directly coupled to the source of the mass spectrometer. The following are suggested columns; an alternative column may be used as long as sufficient peak resolution and separation is achieved.

- Restek Rxi-1ms Fused Silica Capillary Column; 30m x 0.25mm ID 1.0µm film thickness

OR

- Restek Rxi-1ms Fused Silica Capillary Column; 60m x 0.25mm ID 1.0µm film thickness

8.6 Data Systems

IBM-compatible PC with Windows 95/98/NT/XP/7 (Microsoft Office EXCEL version 2003 or newer) and Hewlett Packard Chemstation software including EnviroQuant with Extracted Ion Current Profile (EICP), National Institute of Standards and Technology (NIST) library (2002 version or newer) or equivalent.

8.7 Canister Pressurization Station

Vacuum/Pressure Gauge [0 to -30 inHg; 0-90 or 100 psig]

8.8 Canister Sampling Devices

Refer to the *SOP for Flow Controllers and Critical Orifices* for specific calibration and other pertinent information.

- VICI Condyne Model 300 Flow Controller

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- Critical Orifices (Laboratory manufactured)

8.9 Gas Collection Devices

- Lab Commerce, Aerosphere Model S6L, 6.0L Summa Passivated Canisters or equivalent
- Lab Commerce, Stabilizer Model 22.4L, 2.4L Canisters or equivalent
- Restek Corporation, #24203, 3.0L Silco Canisters or equivalent
- Tedlar bags – 0.5L, 1L, 3L, 5L, 10L, 25L, and 40L (other sizes are available; however, the volumes that are listed encompass the majority of the bags supplied and the samples submitted to the laboratory).

8.10 Dynamic Dilution System

- Entech Dynamic Diluter Model 4620A
- Toshiba laptop computer Model 2210CDT/6.0 and Software NT460

9) Standards, Reagents, and Consumable Materials

9.1 Reagents and Equipment

9.1.1 UHP Grade Helium (99.999%) (GC carrier gas, preconcentrator purge/sweep gas, pressurization gas)
9.1.2 Cryogen - Liquid nitrogen from bulk tank or 50 psig dewars (used to cool preconcentrator traps)
9.1.3 UHP/Zero Grade Air (canister pressurization)
9.1.4 ASTM Type II Water, DI water or equivalent
9.1.5 UHP Grade Nitrogen (99.999%) (additional pressurization gas, based on other methods requested – modification to method)

9.2 Standards

Standards are prepared for both SCAN and Selective Ion Monitoring (SIM) modes according to the procedures detailed in this section. The preparation of standards for the analysis of air samples is carried out by following the procedure, "Preparation of Gas Phase Standards for Ambient Air Analysis", Application Note, Spring 96, Vol. 6.5, *Tekmar*-DOHRMANN AutoCan Users Manual. Neat standards that are used for making trace gas standards must be of high purity; generally a purity of 98 percent or better is commercially available.

9.2.1 Instrument Performance Check, Internal Standard and Surrogate Spiking Mixture
Prepare a standard solution of p-Bromofluorobenzene (BFB-used as both a tune check and surrogate compound), bromochloromethane, chlorobenzene-d5, and 1,4-difluorobenzene, 1,2-dichloroethane-d4(surrogate), and toluene-d8(surrogate) at 500µg/m³ each in humidified zero air (Section 9.2.1.2). Prepare this standard according to the procedure outlined in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note. This standard may also be prepared from a neat cocktail as in Section 9.2.2.2.1 or as stated in Section 9.2.1.3.

9.2.1.1 An intermediate standard is prepared from neat compounds in a glass static dilution bottle (SDB). After the volume of the SDB is determined, calculate the mass of each compound to be spiked to achieve a final concentration of 5.0µg/mL. Then use the density of each neat compound

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to calculate the microliter amount to be spiked into the SDB. The SDB is then heated for a minimum of one hour at ~60°C to completely volatilize all components.

Concentration of the intermediate standard prepared in a SDB is 5.0µg/mL. The amount required to achieve this concentration is determined through the use of the following equation.

$$A = \frac{(C)(V)}{D} \qquad \text{(Equation 1)}$$

Where:

A Amount of each compound required to achieve the desired concentration of the standard in the SDB (µL)
C Desired concentration of SDB (µg/mL)
V Actual volume of the SDB (mL)
D Density of the compound in question (µg/µL)

Example:

Calculate the amount of neat bromochloromethane needed to achieve the final concentration of 5.0µg/mL of that compound in the SDB.

V = 2010mL
D = 1934.4µg/µL
C = 5.0µg/mL

$$A = \frac{\left(5.0\frac{\mu g}{mL}\right)2010mL}{1934.4\frac{\mu g}{\mu L}} = 5.2\mu L$$

Density (µg/µL)	Compound
1934.4	Bromochloromethane
1170.1	1,4-Difluorobenzene
1157	Chlorobenzene-d5
1307	1,2-Dichloroethane-d4
943	Toluene-d8
1593	BFB

9.2.1.2 The Working standard is prepared in a Summa canister by spiking an aliquot of the stock SDB standard (Section 9.2.1.1) using a heated gastight syringe. Connect a cleaned, evacuated Summa canister to a source of pure diluent gas (humidified zero air) using a Teflon line with a stainless steel tee directly above the canister valve. One port of the tee is fitted with a septum. Spike the SDB stock and following removal of syringe a small flow of diluent gas to flush the spike into the can.

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Pressurize the can to positive 83.3 psig with humid zero air, and allow the contents to equilibrate for approximately 24 hours before using.

Concentration of the working standard prepared in a Summa canister is 500ng/L. The final pressure of the canister is 83.3psig; therefore, the pressurized volume is 40L, which is obtained through the use of the following equation.

PV = PDF(V) (Equation 2)

Where:

PV Pressurized canister volume (L)

PDF Pressure Dilution Factor, where PF = $\frac{P_{atm}+P_f}{P_{atm}+P_i}$

P_f Final Canister Pressure

P_i Initial Canister Pressure

V Volume of canister at 1atm

P_{atm} Atmospheric Pressure = 14.7psig

Example:

$$\frac{14.7+83.3}{14.7+0}(6L) = 40L$$

In order to prepare the canister with a concentration of 500ng/L, it must be determined how much of the intermediate standard is required. This is achieved through the use of the following equation.

$$A = \frac{(F)(V)}{(C)\left(1000\frac{ng}{\mu g}\right)} \quad \text{(Equation 3)}$$

Where:

F Desired concentration of working standard (ng/L)

V Pressurized Volume of Canister (L)

C Concentration of prepared SDB (µg/mL)

A Amount of standard (mL) of the SDB required to obtain the desired working standard concentration

Example:

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$$A = \frac{500\frac{ng}{L}(40L)}{\left(5.0\frac{\mu g}{mL}\right)\left(1000\frac{ng}{\mu g}\right)} = 4mL$$

9.2.1.3 Currently the working standard is purchased in a cylinder at a certified concentration of 500ng/L (prepared by Spectra Gases Inc, Alpha, NJ).

9.2.1.3.1 For SCAN analyses, the working standard is filled directly into a summa canister to a pressure of 70 to 80 psig.

9.2.1.3.2 For SIM analyses, the working standard is diluted and pressurized with humid zero air to the desired concentration using Equation 2 in Section 8.2.1.2. Typical concentrations will be 20ng/L, 40ng/L or 50ng/L.

9.2.2 Initial Calibration (ICAL) Standard Prepare the primary source calibration standards in Summa canisters with nominal concentrations of 4ng/L (optional), 20ng/L and 200ng/L for analyses in SCAN mode and 0.1ng/L and 5.0ng/L, 20ng/L for analyses in Selective Ion Monitoring (SIM) mode for each of the target analytes. Differing injection volumes will create the standard concentrations listed in Tables 3 (SCAN) and 3A (SIM) of this document. The full list of analytes which are analyzed according to this method can also be found in Tables 2 (SCAN) and 2A (SIM).

Standards are prepared by diluting the stock standard with humid zero air into a Summa canister. The stock standard is a certified custom-blended cylinder (prepared by Spectra Gases Inc, Alpha, NJ). Refer to Tables 3 and 3A for the list of analytes and certified concentrations in the purchased cylinder.

9.2.2.1 Working standards are prepared into Summa canisters using the Entech Dynamic Diluter. Turn on the power to the diluter one hour prior to using to allow for the components to come to thermal equilibrium. Connect the computer and start the software. Connect a Zero Air source to the humidification chamber (flow controller #1). Connect stock standard cylinder#1 to flow controller #2 inlet. Open the cylinder valves. Adjust the inlet pressures to 50 to 60psig.

Standard Concentration Selection: The concentration of the two working standards prepared in Summa canisters should be 200ng/L and 20ng/L or 200ng/L, 20ng/L and 4ng/L (depending on the dynamic range of the initial calibration-include 4ng/L if a 0.1ng on column standard is desired or this standard may be used for the 0.5ng/L concentration as well) for SCAN and 0.1ng/L and 5.0ng/L, 20ng/L for SIM.

Position 1 – Total Air Flow (Zero Air)
Position 2 – Standard Flow (Purchased Standard One)
Position 3 – Standard Flow (Purchased Standard Two if Applicable)
Position 4 – Total Air Flow (Zero Air) (utilized if preparing a two dilution standard)

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Position 5 – Diluted Standard Flow (utilized if preparing a two dilution standard)

Step1: Determine the required flow rate of the stock standards (positions #2 and #3). The range must be from 5 to 50sccm (standard cubic centimeters per minute, same as ml/min). The flows listed below are guidelines to be used for the default standard flow (based on the desired standard concentration) and were chosen based on the ultimate final dilution required and limitations of the Dynamic Diluter (flows must be from 150 to 2000ml/min.).

Desired Standard Conc.	Default Standard Flow
200ng/L	50ml/min
100ng/L	50ml/min
20ng/L	20ml/min
5.0ng/L	10ml/min
4.0ng/L	8ml/min
0.1ng/L	10ml/min (See Note 1 below)

Note 1: For the 0.1ng/L standard (or another two dilution standard), a slightly different procedure is performed. In order to prepare this standard, two dilutions must be performed. Unscrew the cover of the dilutor and connect the first mass flow controller as well as the tubing to re-route the first dilution output from the final standard Summa canister to the 2nd dilution chamber. Refer to example 2 for the calculation guidelines to prepare a two dilution standard.

Example 1: Prepare a 200ng/L working standard. The concentration of each stock standard is 1000ng/L.

Step 2: Determine the required dilution factor for each stock.
Dilution factor = Stock Conc. (ng/L) / Desired Standard Conc. (ng/L)
Dilution Factor = 1000ng/L / 200ng/L = 5

Step 3: Calculate Total Flow
Total Flow= (stock std. flow-see table above)*(Dilution Factor)
Total Flow=50ml/min*5 = 250ml/min

Step 4: Calculate Diluent Air Flow
Air Flow=Total Flow-(Sum of stock std. flows-purchased cylinders)
Air Flow=250ml/min-(50+50)ml/min = 150ml/min

Example 2: Prepare a 0.1ng/L working standard. The concentration of each stock standard is 1000ng/L.

Step 2: Determine the required total dilution factor for the 0.1ng/L standard.
Dilution factor = Stock Conc. (ng/L) / Desired Standard Conc. (ng/L)
Dilution Factor = 1000ng/L / 0.1ng/L = 10,000

The two dilutions must be performed which total the dilution factor calculated above. Since the flow for the Diluter is restricted to a

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maximum of 2000ml/min, the total flow (as calculated in Step 3 below) cannot exceed 2000ml/min; therefore, the dilutions must be chosen accordingly.

Step 3: Calculate Total Flow
Total Flow = (stock std. flow-see table above)*(Dilution Factor)
Total Flow (Dilution 1) = 10ml/min*200 = 2000ml/min

For the 2nd dilution take the stock standard flow selected for dilution 1 for the two purchased cylinders (10ml/min each based on the desired final concentration) and add them together (10ml/min + 10ml/min for 20ml/min) to get the stock standard flow for the 2nd dilution.

2nd Dilution Factor Needed = Total Dilution/1st Dilution
2nd Dilution Factor = 10000/200(1st dilution) = 50
Total Flow (Dilution 2) = 20ml/min*50 = 1000ml/min

Step 4: Calculate Diluent Air Flow
Air Flow=Total Flow-(Sum of stock std. flows-purchased cylinders)
Air Flow=2000ml/min-(10+10)ml/min = 1980ml/min (Dilution 1)
Air Flow=1000ml/min-20ml/min = 980ml/min (Dilution 2)

Position 1 = 1980ml/min
Position 2 = 10ml/min
Position 3 = 10ml/min
Position 4 = 980ml/min
Position 5 = 20ml/min

Step 5: Enter flow rates in the appropriate fields in the Entech software. Start flows by clicking the "GO" button in the top right of the window. Allow flows to equilibrate for at least fifteen minutes, then attach an empty canister to the outlet port and open the valve. The outlet pressure will be displayed in the lower right of the window, in units of psia. Close the canister valve when the pressure reaches 30psia. There is a relief valve on the diluter that will open when the pressure reaches 35psia, so the canister will still be usable if the valve is not closed in time.

9.2.2.2 When analysis of additional (extra) compounds are requested which are not in the purchased stock cylinders, the following preparation instructions should be used. In addition, the internal standard / surrogate standard may also be prepared in this manner (Sections 9.2.2.2.1 – 9.2.2.2.2) as mentioned in Section 9.2.1.

9.2.2.2.1 *Equi-mass "soup"* (contains compounds in equal mass amounts) or *cocktail* prepared from the neat compounds for a large number of components. If additional SIM compounds are requested, the same cocktail may be used.

Cocktail Preparation:
Step 1: This cocktail is prepared by combining 25mg of each neat compound into a small glass vial. Use a microliter syringe to transfer each compound, cleaning with solvents in between.

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Put the vial in the freezer between aliquots to minimize volatilization. Take the density of each compound into account to determine the actual amount of each compound to spike into the cocktail by using the following equation.

$$S = \frac{A}{D} \qquad \text{(Equation 4)}$$

Where:
S Actual spike amount (µL)
A Desired amount for each compound (mg)
D Density (mg/µL); refer to Table 2 for the density

Example: The actual volume of acrolein to add to the cocktail is calculated by the following.

$$S(\text{Acrolein}) = \frac{25mg}{\left(0.840\frac{mg}{\mu l}\right)} = 29.8\mu L$$

Step 2: The concentration of each compound in the cocktail is determined by the following equation.

$$C = \frac{A}{V}\left(1000\frac{\mu g}{mg}\right) \qquad \text{(Equation 5)}$$

Where:

C Concentration of cocktail (µg/µL)
A Amount of each compound (mg)
V Final volume of cocktail (total spike volumes of each compound) (µL)

Example:

$$C = \frac{25mg}{631.8\mu L}\left(1000\frac{\mu g}{mg}\right) = 39.569\mu g/\mu L$$

8.2.2.2.2 *An intermediate standard* is prepared from neat compounds by spiking individual compounds into a glass static dilution bottle (SDB) as described in Section 9.2.1.1 or spiking an aliquot of a cocktail into the SDB. The spike amount of a cocktail is determined by using the following equation.

$$S = \frac{C_1 V}{C_2} \qquad \text{(Equation 6)}$$

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Where:

S Spike amount required in order to obtain the desired concentration (µL)
C_1 Desired concentration of SDB (µg/mL)
C_2 Concentration of cocktail (µg/µL)
V Volume of SDB (L)

Example: Determine the spike amount of the cocktail required to achieve the desired intermediate standard concentration.

$$S = \frac{\left(1\frac{\mu g}{ml}\right)(2010ml)}{27.81\frac{\mu g}{\mu L}} = 72.28\mu L$$

9.2.2.2.3 *Intermediate Standard Preparation (Gaseous Compounds)* As an alternative to the glass SDB method, if the extra compounds needed to be analyzed are gases at room temperature, use a gastight syringe to prepare an intermediate standard in a 1L Tedlar bag filled with humidified zero-grade air. Use the molecular weight of the compound to calculate the microliter amount to be spiked into the bag to achieve desired concentration. The spike amount is determined by using the following equation.

$$S = \frac{C * V * 24.46}{M * \left(1000\frac{ng}{\mu l}\right)}$$

S Spike amount required in order to obtain the desired concentration (µl)
C Desired concentration (ng/L)
V Volume of the Tedlar Bag (1L)
M Molecular Weight of the compound
24.46 Molar Volume of gas at 25°C, 1atm

Example:

Make a 100,000ng/L intermediate standard of Chloro-difluoromethane (Freon22) in a Tedlar Bag, where M=86

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$$S = \frac{100{,}000\frac{ng}{L} * 1L * 24.46}{86 * \left(1000\frac{ng}{\mu l}\right)} = 28.44\mu l$$

9.2.2.2.4 *The Working standard* for extra compounds is prepared in a Summa canister by spiking an aliquot of the intermediate standard (glass SDB or Tedlar bag) using a heated gastight syringe. The preparation of these standards shall follow the instructions detailed in Section 9.2.1.2. The concentrations for working standards are usually 20 and 200ng/L, however different concentrations can be chosen which work best for a particular project.

9.2.3 Initial Calibration Verification (ICV) - (Laboratory Control Sample - LCS) Prepare a secondary source standard (either a different manufacturer or different lot from the same manufacturer as the initial calibration standard) using the same procedures as the primary source. The ICV/LCS working standard should contain each target analyte present in the calibration working standard. Prepare the ICV/LCS working standard at a concentration of 200ng/L. Differing injection volumes account for the allowed concentrations listed in Table 4 for SCAN and 4A for SIM. The preparation of this standard shall follow the instructions detailed in Section 9.2.2, using the certified second-source standard cylinder.

9.2.4 Continuing Calibration Verification (CCV) Standard The CCV is the same as the initial calibration working standards detailed in Section 9.2.2.

9.2.5 Screening Standards Recommended procedure: Prepare a 0.5ug/mL and/or a 3.0ug/mL concentration standard so that the GC may be calibrated utilizing a few levels (may include approximately 0.5ng, 150ng and 600ng). However, other concentrations can be prepared depending on the desired range.

Any of the desired standard concentrations (primary and secondary) may change as long as the equations and the appropriate densities remain the same.

9.3 Storage and Expiration Dates

All standards that are to be stored in a freezer shall be stored at ≤-10°C for DoD projects.

- Neat Stock Liquids are stored at < -10°C (-10°C to -20°C) as specified by the manufacturer or for a period of five years.
- Equi-Mass Primary Stock Standard is a cocktail or soup of neat compounds (containing compounds in equal mass amounts) used to in preparing intermediate gas phase standards and shall be stored in the freezer at < -10°C (-10°C to -20°C) for up to six months. This is assuming that the soup is sealed with a septum-containing screw cap or Mininert™ valve. The selection of the compounds for the soup should be performed in accordance with the guidelines in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note.

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- Purchased Stock Standards Cylinders must be stored at laboratory temperature for a period of 2 years or as specified by the manufacturer before vendor re-certification or purchase of new standards.
- Intermediate Calibration Standards prepared by static dilution must be stored in an oven at a temperature of approximately 60°C to ensure analyte vaporization. Every time a standard is prepared from the static dilution bottle (SDB), the concentration changes. To increase the useful lifetime of an SDB standard, remove volumes of 25mL or less. The volume removed can be manipulated by increasing the SDB concentration or by adjusting the canister final volume/pressure. Depending upon the volume removed, an SDB intermediate standard is stable for approximately two months as long as new working standards made from this standard continue to meet acceptance criteria. These bottles must be in the oven for a minimum of one hour prior to use in preparing working standards. The guidelines for the storage and expiration date for the intermediate calibration standards are stated in Volume 6.5 of the *Tekmar*-DOHRMANN Application Note.
- Prepared Stock / Intermediate Calibration Standards prepared in Summa canisters (1000ng/L) may be stored at laboratory conditions for up to three months in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.
- Calibration or Working Calibration Standards prepared in canisters may be stored at laboratory conditions for one month in an atmosphere free of potential contaminants. Upon preparation, canister standards should be allowed to sit for approximately 24 hours prior to use in order for equilibration to take place. Shorter equilibration periods may be necessary and acceptable as long as performance criteria are met.

10) Preventive Maintenance

10.1 A maintenance log will be kept documenting maintenance performed on each analytical system. The serial numbers of each instrument shall be recorded, and each log entry must include a description of the maintenance performed and be initialed by the analyst performing or observing/authorizing maintenance by an outside contractor.

The instrument maintenance log must be kept current. An entry shall be made in the appropriate log every time maintenance is performed (no matter the extent). The entry in the log must include:

(a) The date of maintenance
(b) Who did the maintenance
(c) Description of the maintenance
(d) Proof that the maintenance activity was successful

A notation of a successful tune and continuing calibration or initial calibration and the file number that accompanies the data will serve as proof that the maintenance is complete and the instrument is in working order.

The extent of the maintenance is not important, however, it is important that a notation be included for each maintenance activity such as changing a column, tuning the instrument, changing the pump oil, cleaning the source, ordering a part. In addition, a

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notation should be made in the logbook stating that no samples were analyzed during the days that the instrument was down and no active maintenance was being conducted (i.e., where no other notation was made in the logbook for those days).

10.2 Concentrating Trap

Routine maintenance includes periodic solvent cleaning of the Silco steel lines in the valve oven if contamination is suspected. Also, periodic replacement of the multi-sorbent or partial replacement of the trap if analyte specific deterioration is detected is required. For specific trap information refer to the instrument maintenance logbook and electronic method manual.

After repacking, the trap should be baked at 265°C for a minimum of two hours (or until a clean blank is generated) and a partial repacking requires baking (at 265°C) the trap for a minimum of 20 minutes (or until a clean blank is generated).

10.3 GC System

Column performance is monitored by observing both peak shapes and column bleed. Over time, the column will exhibit a poor overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced (see Section 7.4). Whenever GC maintenance is performed, care should be taken to minimize the introduction of air or oxygen into the column.

Clipping off a small portion of the head of the column often improves chromatographic performance. When cutting off any portion of the column, make sure the cut is straight and "clean" (uniform, without fragmentation) by using the proper column-cutting tool. When removing any major portion of the column, which will affect the retention times and elution characteristics, a change in instrument conditions may be required to facilitate nominal analytical activity.

Declining performance can also be due to ineffective column ferrules, which should be replaced when a tight seal around the column is no longer possible. This can be detected with the use of a leak detector.

10.4 Mass Spectrometer

The Mass Selective Detector (MSD) ion source requires periodic cleaning to maintain proper performance. Symptoms of a dirty ion source include difficulty keeping the MSD in tune and fluctuating internal standard areas. The vacuum system should be serviced every six months, including changing the pump oil and checking the molecular sieve in the back-streaming trap.

10.5 Instrument Tuning

The instrument is tuned with guidance from the procedure described in the HP Operations Manual, when necessary.

10.6 Computer Troubleshooting

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Computer care and troubleshooting is conducted by the IT department. Refer to Section 8.5 for the computer hardware and software requirements.

Computers are selected to meet or exceed operating system and or acquisition software requirements. Periodic upgrades of memory are performed to maintain or improve system performance and reliability. Upgrades may be performed on systems until instrument hardware configurations become the limiting factor.

Basic Troubleshooting Outline:

1) Document occurrence and severity in IT Log
2) Interview user(s)
3) Investigate any available logs (Event Logs, Acquisition Logs, etc.)
4) Determine if problem is isolated (single user or acquisition) or widespread (multi user or network).
5) If multiple possibilities exist for cause, then eliminate in systematic manner.
6) Hardware issues are addressed with component replacement (beginning with most suspect portion).
7) Software issues are addressed first with internet investigation (user blogs, software source updates/findings).
8) Network issues are investigated from the Server, to Switch, to Network Card; utilizing all available managed devices to help discover possible failure points.
9) In some cases, system corruption may require reload or complete system replacement.
10) Finalize documentation in IT Log with actions taken
11) Perform periodic follow-up with User and review any log found to have suspect events that suggested source of issue.

11) Procedure

11.1 Sufficient raw data records must be retained on file of all laboratory analyses described in this document including passing QC canister checks, tune checks, instrument calibrations, verifications, sample analyses and dilutions, QC checks, and method detection limit studies. The information that is required includes: analysis/calibration date and time, test method, instrument, sample identification, analyte identification, analyst's initials, concentrations and responses, as well as standards used for the analysis and calibrations, all manual calculations including sample dilutions and manual integrations to permit reconstruction of analyses. Information entered and reported on the quantitation report and instrument run log must be complete and accurate. All data shall be obtained following defensible and ethical practices in accordance with the most recent Quality Assurance Manual and the *SOP for Laboratory Ethics and Data Integrity.*

Note: All data records must explicitly connect data to the initial instrument calibration. This includes all samples, continuing calibrations and QC samples.

11.2 Sample Preparation

The pressure/vacuum is checked and the canister pressurized upon receipt by the laboratory, as needed. When necessary, canisters shall be pressurized with humidified zero grade air. However, if the samples are to be analyzed in accordance with EPA Method 3C then the samples must be pressurized with UHP Helium (refer to Section 11.12 for additional information). The client must be made aware of this in advance and

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given the option of either submitting two canisters for analysis or receiving a report with qualified results (TO-15 Modified).

Depending on the size of the canister and location of sampling and as specified in the SOP below, samples may be pressurized to approximately 1.0psig to 3.5psig. Additional information may be found in the *SOP for Evaluation and Pressurization of Specially Prepared Stainless Steel Canisters*. Initial and final pressures are recorded in LIMS and should be repeated on the back of the sample tag. The dilution factor created by filling the sample canister is calculated using equation number 12 in Section 13.8.

11.3 Screening

The analyst must screen a sample or subset of samples if the source is of unknown origin. Typically, if the source is known to be indoor or ambient outdoor air, no screening is necessary. However, if screening is required make sure that the instrument is calibrated. A single point calibration is sufficient; however, the instrument may be calibrated utilizing a two point calibration. The ICAL points are recommended to be at approximately 0.5ng, 150ng and/or 600ng spanning the desired dynamic range. Refer to Section 9.2.5 for additional information.

Inject a 1mL or smaller aliquot of each sample into a GC/flame ionization detector (FID) system that has been calibrated with a standard containing a subset of the target analytes. This subset represents the most commonly found compounds in air samples, such as acetone, trichloroethylene, and toluene. Use the results to determine the maximum volume of sample to be analyzed by TO-15 by utilizing the following equation. Dilutions may be prepared as necessary according to Section 11.12.1.

$$I = \frac{C}{H}$$ Where:

I Injection volume (mL)
C Maximum calibration level (ng on column)
H Compound screening concentration (ng/mL)

Example: Select the compound with the highest concentration (toluene = 1.0ng/mL). If the upper calibration level is 100ng on column, then the following calculation determines the maximum injection volume to analyze.

$$\frac{100ng}{1.0ng/mL} = 100\text{mL maximum injection volume}$$

11.4 Analytical Sequence and Data System Setup

11.4.1 Data System For the Tekmar AUTOCAN, fill in the sequence log of the Teklink program with the appropriate information. Refer to the Section 11.5.1 for the operating parameters.

For HP Chemstation, load the appropriate acquisition method for the GC/MS in the top window of the Chemstation program. Suggested GC/MS operating parameters are given in Section 11.5.2.

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11.4.2 Analytical Sequence The analytical sequence must be completed for the analysis of ≤20 (19 samples including dilutions with one laboratory duplicate) field samples. A method blank (MB) shall be run to monitor for laboratory introduced contamination. There must be at a minimum a laboratory duplicate (LD) analyzed in each batch to access batch precision. The following generalized analytical sequence is to be followed:

Analytical Sequence Guideline

With Calibration	Tune Check[1] Calibration Standards (5 Standards Minimum) ICV Standard[2] (Acts as the ICV and LCS) QC Canister Checks[6] MB[7] Sample(s) – 1-19 Laboratory Duplicate[4]
With Continuing	Tune Check[1] CCV Standard[5] QC Canister Checks[6] MB[7] LCS[3] MRL Check Standard[8] Sample(s) – 1-19 Laboratory Duplicate[4]

[1] The instrument performance check solution must be analyzed initially and once per 24 hour (or as specified by the project) time period (sequence / tune window) of operation. All analyses for a sequence must be initiated (injected) prior to the expiration of the tune window.
[2] In this scenario, the ICV may also be evaluated as the LCS (differing acceptance criteria).
[3] An LCS shall be analyzed at a rate of 1 in 20 or fewer samples. The LCS is the second source calibration check standard analyzed at the lower end of the calibration curve (below the midpoint).
[4] A laboratory duplicate must be analyzed at a rate of 1 per 20 or fewer samples. The duplicate must be rotated among clients, whenever possible. Also, a duplicate laboratory control sample may be analyzed to assess precision to meet project requirements or due to sample matrix effects.
[5] A CCV must be analyzed at the beginning of every analytical sequence.
[6] Any number of QC check canisters may be analyzed in the sequence to determine a canister cleaning batch or batches acceptability.
[7] Any of the QC Check Canisters may serve as the method blank as long as the minimum requirements detailed in this document are met. A method blank shall be analyzed at a rate of 1 in 20 or fewer samples.
[8] A MRL check standard may be analyzed with each batch of 20 or fewer samples (when an initial calibration is not analyzed within the same batch). Additional information is included in Section 11.18.

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Note: Client project batch specifications may require certain modifications to the analytical sequence; however, a batch may not be more lenient than that which is specified in this document.

11.5 Conditions

11.5.1 Sample Collection Conditions The suggested settings and system parameters are as follows:

Adsorbent Trap

Set Point:	35˚
Sample Volume:	up to 1L
Dry Purge:	300mL
Sampling Rate:	100mL/min (utilize for a sample injection volume of >100mL); 40mL/min (utilize for a sample injection volume of 25-100mL)
Desorb Temp.:	230˚C to 240˚C
Desorb Flow Rate:	8-10mL/min He
Desorb Time:	3.0 minutes

Refocusing Trap

Temperature:	-180˚C
Injection Temp.:	160˚C
Injection Time:	1.0 min

Adsorbent Trap Reconditioning Conditions

Temperature:	265°C
Initial Bakeout:	2 hours or until clean blank is obtained
After each run:	5-8 minutes

Sample Run Time

Each analytical run is approximately 20 minutes long; the total cycle time is about 30 minutes between injections.

11.5.2 GC/MS System

Optimize GC conditions for compound separation and sensitivity.

Item	Condition
Carrier Gas	Helium
Flow Rate	1.0-1.5mL/minute
Temperature Program	Initial Temperature: ~20˚C Initial Hold Temperature: 3 minutes Ramp Rate: 5˚C/min to 80˚C 2nd Ramp: 10˚C/min to 160˚C 3rd Ramp: 20˚C/min to 240˚C for 5 min hold
Detector B (MSD *Interface)*	260˚C

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Electron Energy	70 Volts (nominal)
Mass Range (Scan mode)	34 to 280 amu
Mass Range (SIM mode)	Scan masses corresponding to the target analytes
Scan Time	To give at least 10 scans per peak, not to exceed 1 second per scan.

Note: The instrument may be operated in Selective Ion Monitoring (SIM) mode if requested by the client.

11.6 Instrument Performance Check

Since the BFB tuning compound is included in the internal standard and surrogate standard canister and an autosampler is used, it is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to the reduction and approval of any data collection. The 24-hour time period for GC/MS instrument performance check and standards calibration (initial calibration or continuing calibration verification criteria) begins at the injection of the BFB, which shall be documented in laboratory records. Upon completion of the successful BFB tune, the tune report must be printed and retained on file for future reference.

The mass spectrum of BFB must be acquired in the following manner.

- Inject 50ng or less (on column)
- Three scans (peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged.
- Background subtraction is conducted using a single scan prior to the elution of BFB.
- All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.
- The ion abundance criteria must not be changed from the requirement stated in this document (TO-15 or TO-14A, as requested).

All subsequent standards, samples and QC samples associated with a BFB analysis must use identical instrument conditions.

11.7 Initial Calibration

The initial calibration is performed to determine instrument sensitivity and the linearity of the GC/MS response for the target compounds.

Initial calibration requirements are as follows:

1. A minimum of 5 concentrations must be used to calculate the calibration curve.
2. An initial calibration must be performed at a minimum initially per instrument, annually thereafter or whenever the continuing calibration verification standard does not meet the acceptance criteria.
3. Highest concentration, together with the lowest concentration, defines the calibration range.
4. The method reporting limit for any reported analyte must be at >/= the lowest calibration point.
5. The initial calibration event may not be interrupted by maintenance.
6. Only one value per concentration may be used.
7. Analyze calibration standards from lowest to highest concentration.

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8. All ICAL analyses must be completed within the 24-hour tune window.
9. If 5 calibration standards are in the ICAL, one standard may be re-analyzed. If 6 to 10 calibration standards are in the ICAL, two calibration standards may be re-analyzed.
10. One of the calibration points from the initial calibration curve must be at the same concentration as the continuing calibration verification standard.
11. The upper end of the calibration range must not exhibit any peak saturation for any analyte or the range must be lowered accordingly.
12. The initial calibration model must be linear calibration using average of response factors and cannot be changed for any reason.
13. Point dropping policy
    - Minimum of 5 consecutive concentrations must be used to calculate the calibration curve.
    - Lowest concentration must be at or below the MRL (LOQ) and may not be dropped unless the MRL is changed to the concentration of the remaining lowest standard.
    - Points at the high end may be dropped, but doing so lowers the calibration range.
    - Points may not be dropped from the interior of the curve unless an assignable cause (i.e., gross dilution error, missing internal standards, purge malfunction, standard preparation error, or instrument malfunction) is accounted for and documented. In these instances, all the analytes in that calibration standard must be dropped from the calibration curve as the corrective action (the reason must be documented and the results maintained with the documentation for the final ICAL).
    - Dropping individual compound points from the upper or lower end of the calibration range to improve linearity is not considered an error correction. The reason for dropping these points does not need to be documented but the ICAL documentation must state the revised calibration range if the MRL must be adjusted or the calibration range is lowered for a particular compound. This must be documented on the ICAL Review Checklist.
    - A calibration standard may be re-analyzed if the first analysis of the standard has been dropped and other requirements in this policy are met (i.e., still within 24 hours).
    - Once the ICAL has been used to calculate and report sample results it MUST not to be changed for any reason.
    - It is recommended that if an analyte has a higher MRL than the lowest concentration analyzed that the low standard be automatically dropped from the curve (i.e., acetone MRL is 5, drop at least the 0.5ng point).

11.7.1 Calibration Points Analyze the calibration standards (analyze low to high) that span the monitoring range of interest of the samples. For SCAN, the range is typically 0.5ng-100ng on column; however, 0.1ng on column may be added if low level analyses are requested. For SIM, the range is 10pg on column to 20,000pg on column. The dynamic range is dependent on the sensitivity of a particular instrument as well as the required reporting limit for a given project and may be adjusted accordingly. Refer to Table 3 (SCAN) and Table 3A (SIM) for the concentrations of the compounds of interest in the initial calibration at each particular calibration concentration level.

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Note: Refer to the EXCEL TO-15 Standard Concentration templates, located on the network at Q:\\TO15 Std. Concentrations\Std. Conc. Templates for both the SIM and SCAN templates. These templates must be utilized for the documentation of the standard canister concentration selection, final ICAL level concentrations and the determination of the correct injection volumes for the selected standard canister concentrations. If the primary or secondary stock standard cylinder concentrations are revised (upon re-certification or new purchases), the EXCEL spreadsheet templates, injection amounts and the ICAL concentrations in each instrument method must be adjusted accordingly. Other templates may be employed as long as they are validated and provide at least the same information.

SCAN

1. Determine if the lower end of the calibration range is to be 0.1ng or 0.5ng on column. If the low end is 0.1ng, then the 4ng/L standard must be utilized.
2. Determine if the 4ng/L or 20ng/L standard canister is to be used for the 0.5ng on column point.
3. Follow the instructions in the spreadsheet and save the file under the correct instrument folder and the initial calibration method identification.
4. Print the final ICAL concentration sheets and place into the corresponding ICAL folder

11.7.2 Recalibration Each GC/MS system must be recalibrated following any instrument maintenance which may change or effect the sensitivity or linearity of the instrument, if the continuing calibration verification acceptance criteria are not met and at least annually. The following procedure must be followed when updating an initial calibration method.

1. Open the most recent method.
2. Save the method with the new ICAL method ID using the "Save Method As" option. Date used in the method ID must be the date files were analyzed.
3. Quantitate midpoint standard and check retention times and integrations. Update retention times if necessary using QEdit or Easy ID (Tools → Easy ID). Requant if any changes are made and verify all peaks are identified correctly. Print.
   a. While midpoint standard is loaded update reference spectra (Continuing Calibration → Update Reference Spectra).
   b. With midpoint standard loaded update qualifier ion ratios and retention times (Initial Calibration → Update Levels → Select Update Level and then select Retention Times (Replace) and Replace Qualifier Ion Relative Responses).
   c. If necessary adjust integration parameters prior to processing remaining ICAL points.
4. Quantitate remaining ICAL standards. Review each peak for retention time, integration, and print. Review low level standards for acceptable signal to noise ratios and high level standards for saturation.
5. All responses must be cleared from ICAL before updating (Initial Calibration → Clear All Calibration Responses).
6. Update responses for each standard level (Initial Calibration → Update Levels) or (Initial Calibration → Quick Levels Update). If Quick Levels Update is used do not requant datafiles.

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7. Save method.
8. Check Response Factor Report and evaluate whether any points should be dropped following the criteria outlined in this SOP.
9. Save method if any changes are made.
10. Verify calibration files listed on Response Factor Report are correct.
11. Verify file ID, acquisition time, quant time, update time, and last update information is correct on the Calibration Status Report.

11.7.3 Analytical Window If time remains in the tune window after meeting the acceptance criteria for the initial calibration, samples may be analyzed according to the procedure described in this document (see Section 11.4.2). If time does not remain in the analytical window, a new sequence shall commence with the analysis of the instrument performance check compound (BFB) and the continuing calibration verification standard.

11.7.4 Procedure The system should be operated using temperature and flow rate parameters equivalent to those in Section 11.5. Use the standard prepared in accordance with Section 9.2.2 of this SOP. Attach the calibration standard and internal standard/surrogate canisters to the designated inlets on the preconcentrator and open the canister valves. Analyzing different volume aliquots of the calibration standards produces differing concentrations.

Analyte responses (target ion areas) are tabulated and recorded using the Enviroquant program. Quantitation ions for the target compounds are shown in Table 2 and 2A and the primary ion should be used unless interferences are present, in which case the secondary ion may be used, but the reason documented in the initial calibration file and all subsequent quantitations utilizing that ICAL must be performed using the same ion selections. Refer to Section 13.3 for the required calculations and Section 12.3 for the acceptance criteria.

11.7.4.1 Additional Requirements The procedure for performing and generating a new initial calibration method must follow a few additional requirements.

1. If any analyte lacks the appropriate sensitivity (3 to 1 signal to noise ratio) at the low end of the calibration range, this point must be dropped from the curve and the MRL/LOQ raised accordingly.
2. No detector saturation may occur for any compound; the upper calibration level must produce no saturated peaks. Exhibited by:
   - The flattening of the response for the higher concentration standards as shown on the plot;
   - The presence of a reverse tail or rise on the front part of the peak;
   - The observed actual percent ratio of the secondary ion presence is lower than the expected percent ratio; or
   - The presence of a flat topped peak and again by the decline or saturation of the secondary ion compared with the expected % recovery.

11.7.4.2 LOQ Establishment, Verification and Acceptance Criteria

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1. The LOQ must be set within the calibration range (≥ low std. of the current passing ICAL) prior to sample analysis.
2. The LOQ for each analyte must be > the analyte's LOD.
3. Initially a passing demonstration of precision and bias must be performed at the LOQ.
4. Run CCV 2 times at LOQ and:
   a. Generate a duplicate report for precision using ±25% as the criteria.
   b. Check the %Rec using laboratory generated control limits.
   c. Check the signal to noise ratio (S/N) using the software. The S/N ratio must be at least 3:1 for each analyte.
   d. All ion abundances must be acceptable per the requirements set forth in this document.
5. If any compounds fail, verify at a higher level and notify reporting. Also, make a note in the ICAL documentation.
6. Turn in all LOQ verification data (quant reports and software reports/checks) to QA (regardless of pass/fail).
7. Verify the LOQ on each instrument quarterly.

11.7.5 Initial Calibration Review Analyst's calculation and assessment along with a peer review of all ICAL data and documentation as stated in Attachment B is required before the ICAL may be used to analyze samples. In the case where samples are placed on the autosampler and allowed to run overnight, the sample results may only be reported if the ICAL is reviewed and found to be acceptable. The ICAL checklist in Attachment B must be used to document the review and approval process.

Perform a review of specific aspects of the calibration which might compromise data quality such as inappropriate extension of the calibration range with detector saturation and/or a lack of sensitivity for any analyte. Analyte concentrations which do not meet the signal to noise ratio or exhibit saturation are not to be reported and must be eliminated from the initial calibration. These instances should be followed by a short explanation regarding the reason for the omission.

11.7.6 Initial Calibration File An ICAL file is to be created for each initial calibration performed per instrument into which is placed the following ICAL documents. The file shall remain in the laboratory and be filed by instrument and date.

- ICAL Checklist filled out, reviewed and approved
- BFB tune analysis report
- Calibration status report (aka Calibration History)
- Relative Response Factor Report / Percent Relative Standard Deviation
- Quantitation report for each calibration standard (including manual integration documentation – before and after manual integration)
- ICV quantitation report and % recovery report.
- TO-15 Standard Concentration Spreadsheet (exact ICAL level concentrations and ICV concentrations)
- Any manual integration documentation

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11.8 Initial Calibration Verification Standard

Verify the initial calibration by analyzing an initial calibration verification standard (ICV). This standard shall be obtained or prepared from materials acquired from a different manufacturer or lot from that of the initial calibration and prepared according to Section 9.2.3.

Analyze 50ng or less (refer to Table 4 for the secondary source standard concentrations) of the ICV standard depending on the dynamic range of a given instrument and refer to Section 13.5 for the required calculations.

11.9 Continuing Calibration Verification Standard

Verify the calibration each working day, where necessary (e.g., an ICAL was not analyzed or the tune window has closed) by analyzing a continuing calibration verification (CCV) standard from the initial calibration standard canister. The concentration of the calibration verification may be varied between the low calibration standard and the midpoint of the calibration range; however, the concentration must be at one of the levels analyzed in the initial calibration. Refer to Table 3 for the standard concentrations. Refer to Section 13.4 for the required calculations.

11.10 Canister Quality Control Check and Method Blank

The method blank must be a sample of a matrix similar to the batch of associated samples that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure, and in which no target or interferences are present at concentrations that impact the analytical results for sample analyses. Prepare a canister that has not left the building by pressuring with humidified zero air. Analyze an aliquot of one liter along with the same volume of internal standard and surrogate as standards and samples. Additionally, a blank must be analyzed whenever a high concentration sample is encountered and carryover is suspected.

A Quality Control (QC) check canister pressurized with humidified zero air may serve as a method blank as long as the analyte concentration requirements stated in the canister quality control check section (Sections 12.6 and 12.7) and other requirements (refer to Section 12.11 for internal standard requirements) are met. Assuming continuing failure, another QC canister or a new canister must be prepared and analyzed in order to verify that no system contamination exists. For tracking purposes the unique laboratory barcode given to a canister shall be the information included in the sample analysis identification.

11.10.1 Sampling Systems Section 7.1 and 8.4 of Method TO-15 describe the setup and certification procedure for a specific sampling apparatus that has been used by the EPA for several of its large air monitoring programs. These systems are rarely used for the types of projects that make up the bulk of the laboratory's work. The vast majority of samples analyzed by the laboratory are taken into Summa canisters either as grab samples or using a simple time integrated sampling device (flow controller), as in Section 8.2.1 of the method, so these procedures are not part of the typical protocol for providing sampling materials to clients. The laboratory has developed an SOP for the cleaning and certification of the materials it provides its clients for obtaining air samples to be analyzed by

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method TO-15. Refer to the *SOP for Cleaning and Certification of Summa Canisters and Other Specially Prepared Canisters* for additional information.

It is this laboratory's interpretation that the sampler system certification procedure described in Section 8.4.4 of the TO-15 method applies to the specific sampling apparatus described in the method and not to the sampling procedures used by our clients. The laboratory does not maintain a dynamic calibration manifold or canister sampler apparatus as described in the method and thus performance of the relative accuracy certification procedure described in section 8.4.4. is not possible.

11.11 Laboratory Control Sample

The laboratory control sample is a sample matrix, which is free from the analytes of interest and spiked with a standard containing known amounts of analytes. The laboratory control sample is an injection of the initial calibration verification standard. Inject the LCS (ICV) at concentrations below the midpoint of the calibration curve. Make sure that all of the pertinent information is included on the quantitation report including the sample identification (LCS), concentration, standard used, and analyst.

11.12 Sample Analysis

Prior to analysis, all sample containers (canisters and bags) should be at temperature equilibrium with the laboratory.

- Attach sample canisters to Tekmar AUTOCan using a 9/16" wrench.
- Before opening the valve, check for leaking fittings by running the leak check program in the Teklink software.
- If system is leak tight, open the canister valves and start the automated preconcentration procedure. Make sure the Chemstation data acquisition software has been readied.
- Maintain the trap at an elevated temperature until the beginning of the next analysis.

Check all target compounds using the QEdit routine in Enviroquant, making sure all extracted ion chromatogram peaks are integrated properly (see Section 11.16).

Note: *The secondary ion quantitation is only allowed if there is sample matrix interference with the primary ion. If the secondary ion quantitation is performed, document the reasons in the instrument run logbook and/or on the quantitation report (initial and date any notation).*

SCAN Mode - The instrument is normally operated in the SCAN mode, where the following procedure may be followed.

- Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic range from 34 to 270 amu. At least ten scans per eluting chromatographic peak should be acquired. Scanning allows identification of unknown compounds in the sample through searching of library spectra. See operating conditions in Section 11.5.
- Generate a quantitation report for each run.
- If reporting Tentatively Identified Compounds (TICs), refer to Section 11.12.2 for identification criteria.

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SIM Mode - When the client requests SIM mode, select SIM instead of SCAN mode and identify a minimum of two ions per analyte of interest. Also, a minimum of two ions for each internal standard and surrogate compound should be selected.

Helium Pressurization – If a canister is pressurized with helium, a correction factor is applied to sample volumes extracted from the canister via auto sampler. This is due to the difference in thermal properties between helium and air. A correction factor worksheet has been generated to determine the exact volume taken from a canister and may be found at J:\\A-GCMS\Helium Pressurization. Save file, print the sheet and include with the data. Refer to the instruction page in the template for all of the instructions and calculations including backfilled canisters.

AutoCAN Leak Checks – Canisters should be put on at least two different AutoCAN positions to confirm a "leak". In addition, the valve threads should be inspected for defects which may prevent a good seal with the AutoCAN. Once a canister has "failed" the leak check it must be tagged, an NCAR initiated, and the PM notified. Regardless of what the client or PM specifies as the fate of the sample, the canister must be put on maintenance hold to complete a full 24-hour leak check. A yellow sheet is to be completed in addition to, but not in lieu of an NCAR. This is a fixed QA procedure with no allowance for deviation.

11.12.1 Sample Dilution If any target analyte results are above the highest level of the initial calibration, a smaller sample aliquot should be analyzed. The dynamic range of volume aliquots for the automatic cryogenic concentrator is 20cc to 1L. If a volume smaller than 20cc is to be analyzed, a dilution should be made in a Tedlar bag, or the sample directly injected using a gastight syringe. Guidance in performing dilutions and exceptions to this requirement are given below.

- Refer to Section 11.5.1 (Adsorbent Trap Sampling Rate) for the required sampling rate if less than 100mL is to be analyzed.
- Use results of the original analysis to determine the approximate dilution factor required and get the largest analyte peak within the initial calibration range.
- The dilution factor must be documented (and included in the final report) and chosen in such a way as to keep the response of the analyte peak for a reported target compound in the upper half of the initial calibration range of the instrument.

Tedlar bag dilution:

- Make a dilution by filling a Tedlar bag with 1.0 liter of humidified zero air using a one-liter gas syringe.
- Calculate the volume of balance gas needed to obtain the required dilution.
- Remove the difference in the balance gas using a syringe.
- Add the calculated sample amount using a gastight syringe.

Direct injection:

- Make a direct injection by attaching a clean, humidified zero air filled Summa canister to the preconcentrator autosampler using 1/4" stainless steel or teflon tubing with a "tee" septum port. This canister should be the same canister that may be used as the method blank.

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- Inject the sample through the septum while the preconcentrator withdraws a 200cc aliquot from the canister.

11.12.2 Tentatively Identified Compounds When requested, a mass spectral library search may be made for the purpose of tentatively identifying sample components not associated with the calibration standards. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system mass spectral library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Certain programs may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification. The following guidelines are used for making tentative identifications.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within ±20%. For example, for an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance should be between 30 and 70%.
- Molecular ions present in the reference spectrum should be present in the sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.
- Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.
- The concentration of the tentatively identified compound is estimated by assuming a response factor of 1.0 and comparing the response of the tentatively identified compound to the response of the nearest internal standard.
- If non-target analytes are not Q-deleted from the quant report, the analyst must evaluate whether these compounds should be reported as TICS.

11.13 Duplicate

A duplicate must be analyzed to assess laboratory precision and samples selected for duplicate analysis shall be rotated among client samples, where applicable. Some projects or sample matrix issues may require the analysis of a duplicate laboratory control sample (DLCS).

11.14 Internal Standard (IS)

The concentration of internal standard added to each standard, field sample and QC sample must be consistent from that of each current ICAL standard.

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11.15 Surrogates

Internal standards/surrogates must be added at the same volume for every standard, sample and QC sample. Surrogate compound recoveries are requested by a number of clients, but are more appropriately used as system monitoring compounds. This is due to the fact that the compounds are introduced directly into the analytical system and not into the canisters or bags. It is for this reason that they are not considered to be true surrogates and a fixed window is applied. Additionally, surrogates are not included in the ICAL because they are not required by the method and are only system monitoring compounds.

11.16 Manual Integration and Q Deletion

A list of abbreviations (codes) that may be used to give a reason for performing either of these procedures are listed in the *SOP for Data Review and Reporting*.

11.16.1 Manual Integration The integration for each peak must be legally defensible and shall be checked to ensure that it has been integrated properly and consistently between samples, standards and QC samples. All peak reviews and manual integrations must follow the requirements specified in the *SOP for Manual Integration Policy* and the *SOP for Laboratory Ethics and Data Integrity.* The requirements in the above stated procedure include when manual integrations are performed, raw data records shall include a complete audit trail for those manipulations (i.e., chromatograms showing both the integration prior to any manual integrations and those depicting the corresponding manually integrated peaks), and notation of rationale, date, and initials of person performing the manual integration operation. In addition, manual integrations must be reviewed and approved by a second reviewer and the manual integrations maintained in the appropriate job file.

Reporting Requirements Certain project requirements including samples which are submitted under the Department of Defense (DoD) QSM require that the case narrative include an identification of samples and analytes for which manual integration is required. Refer to project requirements to determine if this is necessary.

11.16.2 Q Deletion Q deleting may be performed to either delete a false positive or delete non-target compounds.

11.17 Detection Limits and Limits of Detection

The MDL study shall be performed annually for all target analytes on each instrument (with identical configurations) for which this method is performed. The MDL shall be performed in accordance with the procedure outlined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation.* The detection limit shall be used to determine the LOD for each analyte.

Once determined on each instrument, the highest LOD (for each analyte from all instrument determinations) shall be used as the uniform LOD. However, if a lower detection limit is reported, then the samples must have been run on that specific instrument on which the lower LOD was determined.

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11.17.1 Performance and Acceptance Criteria

1. The MDL must be <0.5ppbV for each analyte (Method 11.11.1).
2. Perform Limit of Detection (LOD) verification on all instruments (performing this method) immediately following the MDL study. Spike the LOD at 1-4x the MDL; the spike level establishes the LOD.
3. LOD Acceptance
   - Analyte must be detected reliably and identified by the method-specific criteria (i.e, ion confirmation) and produce a signal that is at least 3 times the instrument's noise level (3:1 signal to noise ratio).
   - It is specific to each combination of analyte, matrix, method and instrument configuration.
   - The LOD must be verified quarterly on each instrument (spiked at LOD) using the criteria listed above.
4. If the LOD verification fails (per #3), repeat the detection limit determination and LOD verification at a higher concentration or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.
5. The laboratory shall maintain documentation for all detection limit determinations and LOD verifications (regardless of pass or fail).

11.18 Method Reporting Limit Check Standard

It is recommended to analyze a MRL check standard at the current MRL or required MRL for the batch (per client requirements) of twenty or fewer samples if the CCV fails low for any target compound. A MRL check standard may also be required per client specifications.

This check standard can also serve as the LOQ verification if it meets the specific requirements listed in Section 11.7.4.2. Apply the requirements and retain all documentation accordingly. Refer to Attachment D for Minnesota specified MRL check standard criteria.

11.19 Storing Electronic Data

The initial calibration data must be stored in a quantitation method (on the server) using a unique filename and may not be overwritten at any time in order to maintain an accurate audit trail. There are multiple quantitation methods, which are subsets of the compound list in Table 2. Therefore, files will be named with an eight-character notation indicating the compound list and the date of the corresponding initial calibration. In addition, all data files including method blanks, continuing calibration verification, laboratory control samples and client submitted samples files are saved in a unique sub-directory on the server.

12) Quality Assurance / Quality Control Requirements

12.1 To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

12.2 Instrument Performance Check

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Refer to Tables 1 and 1A for the required ion abundance criteria.

12.3 Initial Calibration

- The RRT for each target compound at each calibration level must be within 0.06RRT units of the mean RRT for the compound.
- The calculated %RSD for the RRF for each compound in the calibration standard must be less than 30% with at most two exceptions up to a limit of 40% (this may not be true for all projects).
- For each Internal Standard the area response (Y) at each calibration level must be within 40% of the mean area response $\overline{Y}$ over the initial calibration range.
- The retention time shift for each of the internal standards at each calibration level must be within 20s of the mean retention time over the initial calibration range for each internal standard.
- All of the following information must be retained to permit reconstruction of the initial instrument calibration: calibration date, test method, instrument, analysis date, analyte identification, analyst's initials, concentration and responses, and response factors.
- All initial instrument calibrations must be verified with an acceptable ICV.

12.4 Initial Calibration Verification Standard

The percent recovery for each compound in the ICV must be between 70%-130% for all analytes except vinyl acetate, which must be within 50-150%. Exceptions to this allowance for the vinyl acetate recovery are project specific requirements and any DoD type project, which shall adhere to the 70-130% requirement for all target compounds.

12.5 Continuing Calibration Verification Standard

All compounds must be evaluated prior to rounding. The percent difference for each target analyte must be within plus or minus 30% of the initial calibration average RRFs.

12.6 Canister Quality Control Check

The actual cleaning procedure, number of cans to select for analysis (to release a cleaning batch) and corrective actions are covered in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters* and are not covered in this section. However, the procedure for analyzing and certifying a cleaning batch is included. If a canister passes as a QC canister it meets all of the requirements for a method blank (Method, NELAC\TNI, and Department of Defense Quality Systems Manual – DoD QSM, etc.).

12.6.1 Scan Analyses A canister is considered "clean" for normal SCAN analyses if the analysis shows <0.2ppbv of any target analyte (analyte exceptions listed in table below). If a canister passes as a QC canister it meets all of the requirements for a method blank (Method, NELAC\TNI, and Department of Defense Quality Systems Manual - DoD QSM, etc.).

Low Level SCAN Analyses For those analytes with a MRL of 0.1ug/m3, the QC criteria of <MRL is acceptable; otherwise, <0.2ppbV is required (analyte exceptions listed in table below).

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SIM Analyses Results <MRL will be acceptable as this complies with the <0.2ppbV method requirement.

ANALYTE EXCEPTION LIST					
Compounds	ppbV	On Column (ng)	Compounds	ppbV	On Column (ng)
Target Analytes	0.2	0.50	Acrylonitrile	0.2	0.43
Chloromethane	0.2	0.41	Acetone	1.5	3.5
1,3-Butadiene	0.2	0.44	Ethanol	1.9	3.5
Acetonitrile	0.2	0.33	Vinyl acetate	0.99	3.5
Acrolein	0.65	1.5	1-Butanol	0.23	0.70
Isopropanol	0.28	0.70	Carbon Disulfide	1.1	3.5
2-Butanone	1.2	3.5			

Make a notation on the sample identification tag as to the status of the check and return the canister to the canister conditioning room. Additionally, if the check was found to be acceptable, the quantitation report must be kept on file for future reference

12.6.2 Tentatively Identified Compounds (TIC) If the batch of canisters are to be used for tentatively identified compounds (TIC) analysis, any non-target peaks present in the QC check canister analysis must be evaluated and determined to be less than the TIC reporting limit (10% of the internal standard). The concentration is estimated by assuming a RRF of 1.0 and comparing the response of the TIC to the response of the nearest internal standard.

12.7 Method Blank

- The concentration of a targeted analyte in the blank cannot be at or above the MRL, AND be greater than 1/10 of the amount measured in any associated sample. For any project that requires reported results less than the MRL, all associated measurements found in the MB should result in a qualifier; however, project requirements may differ and must be followed. Refer to DoD requirements listed below.
- The method blank should not contain additional compounds with elution characteristics and mass spectral features that would interfere with identification and measurement of a method analyte.
- For DoD samples, the method blank will be considered to be contaminated if:

  1. The concentration of any target analyte in the blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater);
  2. The concentration of any common laboratory contaminant (acetone, ethanol, carbon disulfide, and methylene chloride) in the blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); or
  3. The blank result otherwise affects the samples results as per the test method requirements or the project-specific objectives.

The laboratory shall evaluate whether reprocessing of the samples is necessary based on the above criteria.

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12.8 Laboratory Control Sample

Round all results to the nearest whole number prior to determining if the acceptance criteria have been met. The percent recoveries must be within the laboratory-generated limits and are referenced in the electronic TO-15 Method Manual. However, Arizona requires the percent recovery for each compound in the LCS to be 70%-130% (to match the ICV requirement). Therefore, the ICV exception for vinyl acetate stated in Section 12.4 requires the percent recovery for AZ samples to be 50-150%.

Note: Client project requirements, AFCEE and DoD requirements shall take precedence over the AZ requirement for AZ samples. Meaning if a sample is collected for a DoD project in AZ, DoD requirements specified in this document and the project specific QAPP (if supplied) are to be followed.

12.9 Sample Results

- Sample results must be quantitated from the initial instrument calibration and may not be quantitated from any continuing instrument calibration verification.
- Samples out of holding time must be handled according to Section 16.
- The field sample must be analyzed on a GC/MS system meeting the BFB tuning, initial calibration, initial calibration verification technical acceptance criteria described in this document.
- All target analyte peaks must be within the initial calibration range, diluted or reported with the appropriate data qualifier.

12.10 Laboratory Duplicate

The relative percent difference must fall within ±25%. This RPD criterion also applies to duplicate laboratory control samples (DLCS).

12.11 Internal Standards

The following acceptance criteria must be applied to each run (except the ICAL – see Section 12.3).

- The area response for each internal standard in the blank must be within ±40 percent of the area response for each internal standard in the most recent valid calibration. (CCV or mid-point from the initial calibration, whichever is most current).
- The retention time for each internal standard must be within ±0.33 minutes of the retention time for each internal standard in the most recent valid calibration. (CCV or mid-point from the initial calibration, whichever is most current).

12.12 Surrogates

Since the matrix precludes the use of true surrogates and there is no established method criterion, acceptable surrogate recoveries are based on a fixed window of 70 - 130%. This is the typical requirement from clients. Additionally, these limits are referenced in SW-846 for use as guidance in evaluating recoveries. These limits are sufficient for evaluating the effect indicated for the individual sample results.

12.13 Method Reporting Limit Check Standard

Per client requirements or if the CCV is biased low for any compound, then evaluate the MRL check standard. Analyte must be detected reliably and identified by the method-

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specific criteria (i.e, ion confirmation) and produce a signal that is at least 3 times the instrument's noise level (3:1 signal to noise ratio). Also, a percent difference +/-50% is recommended.

13) Data Reduction and Reporting

13.1 The essential information to be associated with analysis, such as computer data files, run logs, etc. shall include: Sample ID code, date and time (if the holding time is 72 hours) of analysis, instrument operating conditions/parameters (or reference to such data), analysis type, all manual calculations including dilutions and manual integrations, analyst's initials, sample preparation (pressure readings and balance gas if pressurized with helium), standard and reagent origin, receipt, preparation, and use, as well as calibration criteria, frequency and acceptance criteria, data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions.

13.2 This method has specific requirements including the use of canisters; any modification must be reported accordingly. All reports that fall under the laboratory's certificate of approval (in accordance with NELAC/TNI standards) must include a statement(s) clarifying any deviations from the scope of this certification. Refer to Section 13.11 for additional information and specific items, which require this clarification.

13.3 Initial Calibration

Tabulate each of the following:

13.3.1 Equation Number 1 - **Relative Response Factor (RRF):**

$$RRF = \frac{A_x C_{is}}{A_{is} C_x}$$ where:

A_x is the area response of the analyte quantitation ion.
A_{is} is the area response of the corresponding internal standard quantitation ion.
C_{is} Internal standard concentration, ng.
C_x Analyte concentration, ng.

Note: The equation above is valid under the condition that the volume of internal standard spiking mixture added in all field and QC samples is the same from run to run.

13.3.2 Equation Number 2 - **Average (or Mean) RRF:**

$$\overline{RRF} = \frac{\sum_{i=1}^{N} RRF_i}{N}$$ where:

RRF_i are the individual RRFs from each concentration level in the initial calibration curve.

N is the number of calibration concentration levels.

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13.3.3 Equation Number 3 - **Standard Deviation, SD:**

$$SD = \sqrt{\sum_{i=1}^{N} \frac{\left(RRF_i - \overline{RRF}\right)^2}{N-1}}$$ where:

RRF_i are the individual RRFs from each concentration level in the initial calibration curve.

$\overline{RRF}$ Average (or Mean) RRF of all concentration levels in the initial calibration curve.

N total number of calibration concentration levels

13.3.4 Equation Number 4 - **Percent Relative Standard Deviation, %RSD:**

$$\%RSD = \frac{SD}{\overline{RRF}}(100)$$ where:

SD Standard Deviation calculated in equation number 3

$\overline{RRF}$ Average or Mean RRF

13.3.5 Equation Number 5 - **Relative Retention Time (RRT):**

$$RRT = \frac{RT_C}{RT_{is}}$$ where:

RT_c Retention time of the target compound, seconds.

RT_{is} Retention time of the internal standard, seconds.

13.3.6 Equation Number 6 - **Mean Relative Retention Time ($\overline{RRT}$):**

$$\overline{RRT} = \sum_{i=1}^{n} \frac{RRT_i}{n}$$ where:

$\overline{RRT}$ Mean relative retention time (seconds) for the target compound for all initial calibration levels.

RRT_i Relative retention time for the target compound in level i.

n Number of calibration levels

13.3.7 Equation Number 7 - **Mean Area Response ($\overline{Y}$):**

$$\overline{Y} = \sum_{i=1}^{n} \frac{Y_i}{n}$$ where:

Y_i Area response for the primary quantitation ion for the internal standard for each initial calibration standard.

n number of calibration concentration levels

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13.3.8 Equation Number 8 - **Mean Retention Times ($\overline{RT}$):**

$$\overline{RT} = \sum_{i=1}^{n} \frac{RT_i}{n}$$ where:

$\overline{RT}$ Mean retention time, seconds
RT_i Retention time for the internal standard for each initial calibration standard, seconds.
n number of initial calibration levels

13.4 Continuing Calibration Verification

- Calculate the (RRF) of each target compound using equation number 1 (13.3.1).

13.4.1 Equation Number 9 - **Percent Difference, %D:**

$$\%D = \frac{RRFx - \overline{RRF}}{\overline{RRF}}(100)$$ where, for any given analyte:

RRF_x is the RRF from the CCV being evaluated.
$\overline{RRF}$ is the mean RRF from the current calibration curve.

13.5 Percent Recovery – ICV, LCS, Surrogates, MRL Check Standard

13.5.1 Equation Number 10 - **Percent Recovery (%R):**

%R = X/TV x 100

where
X = Concentration of the analyte recovered
TV = True value of amount spiked

13.6 Duplicate Analysis

13.6.1 Equation Number 11 - **Relative Percent Difference (RPD):**

$$\frac{x_1 - x_2}{\overline{x}}(100)$$ where:

x_1 First measurement value
x_2 Second measurement value
$\overline{x}$ Average of the two values

13.7 Internal Standards (IS)

- Calculate the mean area response $\overline{Y}$ for each internal standard using equation number 7 (Section 13.3.7).

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- Calculate the mean of the retention times for each internal standard using equation number 8 (Section 13.3.8).

13.8 Pressure Dilution Factor (PDF)

13.8.1 Equation Number 12 - **PDF**, for samples collected in Summa canisters:

$$PDF = \frac{P_{atm} + P_f}{P_{atm} + P_i}$$ where:

P_{atm} is the ambient atmospheric pressure, 14.7 psi at sea level.
P_f is the final sample canister pressure, in psig.
P_i is the initial sample canister pressure, in psig. This will most often be a negative value (sub-ambient initial pressure).

13.9 Results

If a canister has been pressurized with Helium and the Tekmar AutoCan was utilized, refer to Section 11.12.

13.9.1 Equation Number 13 - For calculating analyte concentrations in a sample, the starting point is the nanogram amount generated by the HP Enviroquant software, which appears on the quantitation report.

$$ng_x = \frac{A_x ng_{is}}{A_{is}\overline{RRF}}$$ where:

ng_x is the nanogram amount of analyte *x*.
A_x is the area response of the analyte's quantitation ion.
A_{is} is the area response of the corresponding internal standard's quantitation ion.
ng_{is} is the internal standard amount, in nanograms.
$\overline{RRF}$ is the average or mean RRFs

13.9.2 Equation Number 14 - The final analyte concentration, C_x, in units of micrograms per cubic meter (µg/m³), is then calculated from the following:

$$C_x = \left(\frac{ng_x PDF}{V}\right)\left(\frac{1\mu g}{1000ng}\right)\left(\frac{1000l}{1m^3}\right)$$ where:

V is the sample volume analyzed, in liters.
PDF is the sample canister pressure dilution factor.

13.9.3 Equation Number 15 - To convert to units of parts per billion volume (ppbv):

$$ppbv = \frac{\mu g/m^3}{MW} x 24.46 \qquad \mu g/m^3 = \frac{ppbv}{24.46} xMW$$ where:

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MW is the molecular weight (Table 2) of the analyte, in g/mole.
24.46 is the molar volume of an ideal gas at 298 K (25 °C) and 760 mmHg (1 atm), in liters per mole (l/mol).

C_x the final analyte concentration in micrograms per cubic meter.

13.9.4 Equation Number 16 – Helium Pressurization (Injection Amount)

Applicable to canisters pressurized with helium and injected utilizing the mass flow controller of the AutoCAN. For full instructions and calculations, refer to the 1st tab of the template located at: J:\A-GCMS\Helium Pressurization\MFC_GCF_backfill.

13.10 Data Review

The analyst must review data on a real time basis for all calibration and QC data. The QC data must be evaluated by analytical sequence following the data review checklist in Attachment C. The data shall be reviewed and the sample results calculated and assessed by one analyst and reviewed by a second qualified analyst. The data review checklist is used to document the reviews and once it has been completed, initialed and dated it must be filed with each job file.

Initial calibrations must be reviewed in the same manner as QC data with all ICAL documentation retained in a separate file organized by instrument and date. Refer to the initial calibration checklist in Attachment B for the review guideline. The ICAL file must contain all the pertinent information stated in Section 11.7.7.

13.11 Reporting

The results of each test shall be reported clearly, unambiguously and objectively, and shall include all the information necessary for the interpretation of the test results and information required by this laboratory's policy, NELAC\TNI standards, DoD Manual (applicable version, see reference section), client projects, and the TO-15 method including modifications, observances, data qualifiers, and certification information.

If the project requires that results be reported below the MRL (LOQ), but above the LOD all of the requirements specified for normal reporting apply (3:1 S/N ratio and ion abundance). This is regardless of the fact that the results will be qualified as estimated.

13.11.1 Analysis Observations / Case Narrative Summary Form

This form, which is included in the *SOP for Laboratory Storage, Analysis and Tracking*, must be generated when there are specific sample composition information or analysis issues and/or observations. In addition, during the analysis, specific identification information or problems, interferences, calibration issues, flags, and additional/expanded explanation of flags should be added to the form. This form may be modified as long as the sections and basic concepts are reserved. All data qualifiers and flags should follow those listed in the most recent Quality Assurance Manual or as defined in any client requirements.

This form is necessary as a means for documentation. This form, among other information, will be reviewed when compiling the final report and case narrative.

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All information regarding the job shall remain in the file, in order that sufficient documentation is available to recreate the job from sample receipt through analysis, data reduction, and reporting.

13.11.2 NELAC\TNI Requirements

The following items do not comply with NELAC\TNI standard requirements and must be reported accordingly. A statement, however worded, must be included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval.

- Reporting any compound which is not included in the second source standard (ICV or LCS) does not meet NELAC requirements.
- In addition, a report that contains a compound not included on the NELAC certificate of approval must also include the statement listed above.

13.11.2.1 Modifications

Method modifications are also not allowed under NELAC\TNI standards; therefore, a statement, however worded, must be included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval. In addition, the following items are considered to be method modifications and must be reported accordingly.

- Sample collection in gas collection bags
- The pressurization of canisters with nitrogen or helium (if EPA Method 3C is requested) refer to Section 11.12.

13.11.3 Surrogates

Only report surrogates at the request of the client. If any surrogate is out of control, all samples results (with surrogates requested) associated with the surrogate must be reported with the appropriate data qualifier.

13.11.4 DoD Requirements

Report results with the appropriate data qualifiers, if samples cannot be reanalyzed for any reason. In addition and at a minimum, the following situations are to be noted in the case narrative: manual integrations, CCV out of control, and results exceeding the calibration range.

14) Method Performance

14.1 An on-going assessment of method performance is conducted in order to ensure that the laboratory is capable of reporting results which are acceptable for its intended use. Validation of the method is confirmed by the examination and provision of objective evidence that these requirements are met.

14.2 Method Detection Limit (MDL)

The procedure used to determine the method detection limits are as stated in the *Code of Federal Regulations* (40 CFR 136 Appendix B) as defined in the *SOP for Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantitation*. The MDL is

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defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL concentrations are listed in Tables 2 and 2A for both SCAN and SIM modes and were obtained using spiked canisters prepared with humidified zero air, making at least seven replicate measurements of the compounds of interest, computing the standard deviation, and multiplying this value by the appropriate Student's t value for 99 percent confidence. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects. All MDLs, regardless of the mode of operation, meet the method performance criteria of <0.5ppbV.

14.3 Accuracy and Precision

Refer to Section 11.4 in the referenced method for information on replicate precision criteria for method performance. Single laboratory accuracy is presented as the second source initial calibration verification standard, which meets the method performance criteria of 30%. Additionally, laboratory generated control limit data for LCSs are presented for the analytes of interest and may be referenced in the electronic TO-15 Method Manual. Refer to Section 11.7.4.2 for the accuracy and precision requirements for concentrations at the LOQ/MRL.

14.4 Selectivity

Mass spectrometry is considered a more definitive identification technique than single specific detectors such as flame ionization detector (FID), electron capture detector (ECD), photoionization detector (PID), or a multidetector arrangement of these (see discussion in Compendium Method TO-14A). The use of both gas chromatographic retention time and the generally unique mass fragmentation patterns reduce the chances for misidentification.

It is necessary to establish that a given GC/MS meets tuning and standard mass spectral abundance criteria prior to initiating any data collection. Upon sample injection onto the column, the GC/MS system is operated so that the MS scans the atomic mass range from 35 to 300 amu. At least ten scans per eluting chromatographic peak must be acquired. Scanning also allows identification of unknown compounds in the sample by searching through library spectra.

The sample analysis using the GC/MS is based in part on a combination of retention times and relative abundances of selected ions. The retention time of each chromatographic peak should be ±0.10 minutes of the library/reference retention time of the compound. The acceptance level for relative abundance should be set at ±20% of the expected abundance. The data should be manually examined by the analyst to determine the reason for the # flag [(#) = qualifier out of range], if present and whether the compound should be reported as found or if there is matrix interference. A background subtraction may aid in this determination. Manual inspection of the qualitative results should also be performed to verify concentrations outside the expected range.

Specific selectivity information is provided in this section and document (such as relative retention time) as well as in the referenced method. Refer to the method for additional information on selectivity.

- Use NIST Library 98 or newer version

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- The *reference spectra updates* must be performed with every new ICAL utilizing the mid-level standard (minimum). If needed, the reference spectra may be updated sooner with the continuing calibration standard.
- *Retention time updates* must be performed using EasyID and not by updating to the method (InitCal \ Update Calibration). Refer to the Help selection of the software.

14.5 Demonstration of Capability

This laboratory has continuously performed this method since before July 1999. Therefore, ongoing demonstration of capable shall be performed and documented; however, the initial demonstration of method capability is not required.

14.6 Proficiency Testing (PT) Program

The laboratory shall participate in an air and emissions PT study for TO-15. The testing shall be performed in accordance with this document and meet the frequency and proficiency requirements detailed in the DoD QSM Version 4.2 (Requirement Box 43).

15) Pollution Prevention and Waste Management

15.1 All waste disposals shall be carried out in accordance with the requirements detailed in the *SOP for Waste Disposal*. In addition, canisters must be cleaned in accordance with the requirements detailed in the *SOP for Cleaning and Certification of Summa Canister and Other Specially Prepared Canisters*.

16) Corrective Actions for Out-of-Control Data

16.1 Corrective actions shall follow the procedures outlined in the *SOP for Nonconformance and Corrective Action*, where appropriate. Any maintenance which may alter instrument sensitivity or linearity must result in the re-analysis of the entire sequence including the tune compound, ICAL or CCV or any batch QC.

16.2 Tune Does Not Meet Criteria

Perform auto tune or manual tune and then re-analyze BFB. If the BFB acceptance criteria are still not met, the MS must be retuned according to the procedure outlined in the instrument user's manual. Perform necessary maintenance and make notations in the instrument maintenance logbook. It may be necessary to clean the ion source, or quadrupole, or take other necessary actions to achieve the acceptance criteria. An acceptable tune is required for sample results to be calculated and reported.

16.3 Initial Calibration Does Not Meet Calibration Criteria

Follow the initial calibration requirements detailed in Section 11.7 for information on re-analyzing or dropping points and the restriction of maintenance performed during the analysis of the initial calibration standards.

If the initial calibration results are outside the established acceptance criteria, corrective actions must be performed and all associated samples reanalyzed, if reanalysis of the samples is not possible, data associated with an unacceptable initial calibration shall be reported as estimated with the appropriate data qualifiers.

16.4 Initial Calibration Verification Does Not Meet Criteria

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If the initial calibration verification technical acceptance criteria are not met, reanalyze and if it fails again, prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column. Perform a new initial calibration if any performed maintenance has altered instrument linearity and/or sensitivity. Perform another initial calibration or if reanalysis is not possible, data associated with an unacceptable ICAL/ICV shall be reported as estimated with the appropriate data qualifiers.

16.5 Continuing Calibration Verification Results Do Not Meet Calibration Criteria

If the continuing calibration verification technical acceptance criteria are not met, reanalyze and if it fails again, prepare a new canister and analyze. If the criteria are still not met inspect the system for possible sources of the problem and perform any necessary maintenance and make a notation in the maintenance logbook of any steps taken. It may be necessary to clean the ion source or change the column.

If any corrective action and/or reanalysis fails to produce continuing calibration verification within acceptance criteria (analyzed immediately following the initial failure), then either two consecutive successful verifications must be performed following corrective action or a new initial calibration must be performed; however, refer to 16.5.1 below.

16.5.1 Method Reporting Limit Check Standard

If the MRL check standard is unacceptable for any compound (sensitivity; ratio or %D), reanalyze at the same or higher level within the same batch and report data with the CCV flag and case narrative notes accordingly.

16.6 Internal Standards Do Not Meet Criteria

16.6.1 Internal Standard Responses If the problem is with the instrument, perform maintenance. If the problem is with a sample, check for interferences. If the response is high, it is likely that interference is present. In this case, lower the volume or aliquot of the sample and re-analyze. If the problem persists, report the results with the best quality and qualify the results. If the problem is corrected with the lower volume analysis, report those results.

16.6.2 Internal Standard Retention Times If the retention time for any internal standard within the sample changes by more than 20 sec from the latest daily calibration or initial calibration mid-point standard, the GC/MS system must be inspected for malfunctions, and maintenance performed as required. Repeat sample analysis where required.

16.7 Method Blank (MB) Results Do Not Meet Criteria

If the analyte concentration results in the blank do not meet the acceptance criteria repeat analysis with remaining QC canisters until results are acceptable or prepare a canister per Section 11.10. If the analyte results in the blank still do not meet the acceptance criteria the source of the problem must be investigated and measures taken to eliminate the source. Each method blank must be critically evaluated as to the nature of the interference and the effect on the analysis of each sample within the batch.

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Determine whether the contamination is from the instrument or due to contamination in the blank container (if results from the new can are not acceptable then the system is probably contaminated). In all cases, the corrective action (reprocessing or data qualifying codes) must be documented. However, the specific corrective action depends on the type of project the blank is utilized for; therefore, refer (below) to the reporting/reprocessing requirements.

DEPARTMENT OF DEFENSE (DoD) QSM PROJECT: Any sample associated with a blank that fails the criteria shall be reprocessed in the same or subsequent analytical batch, except when the sample analysis resulted in a non-detect. If reanalysis is not performed, the results shall be reported with appropriate data qualifier.

OTHER PROJECT TYPE: Appropriate corrective measures must be taken and documented before sample analysis proceeds. However, if this is not a possibility and the results must be reported follow the reporting requirements stated in Section 17.4.

16.8 Laboratory Control Sample (LCS) Results Do Not Meet Criteria

If the LCS criteria are not met, determine whether the cause is instrumentation or the result of a poor injection. If the problem is instrumentation, perform maintenance and if the problem is with the injection re-analyze the LCS. DoD considers the same analyte exceeding the LCS control limits two out of three consecutive LCS to be indicative of non-random behavior; therefore, this trend should be monitored and the appropriate corrective action taken when it occurs.

16.9 Laboratory Duplicate Results Do Not Meet Criteria

If the duplicate results do not meet the technical acceptance criteria, perform another duplicate analysis. If the results are still unacceptable and the associated samples are not reanalyzed then all of the sample results in the associated batch must be flagged accordingly.

16.10 Sample Results Do Not Meet Criteria

- If the retention time for any internal standard within the sample changes by more than 20 sec from the latest daily calibration or initial calibration mid-point standard, the GC/MS system must be inspected for malfunctions, and maintenance performed as required. Repeat sample analysis as needed.
- If the area for any internal standard changes by more than ±40 percent between the sample and the most recent calibration, check for possible matrix interferences and re-analyze at a greater dilution. If the requirement is still not met and matrix interference is not detected the GC/MS system must be inspected for malfunction and maintenance made where necessary.
- When corrective actions are made, samples analyzed while the instrument was not functioning properly must be re-analyzed or the appropriate data qualifiers must be attached to the results.

To the extent possible, samples shall be reported only if all of the quality control measures are acceptable. If a quality control measure is found to be out of control, and the data must be reported, all samples associated with the out of control quality control measure shall be reported with the appropriate data qualifier(s).

16.11 Sample Holding Time Expired

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The customer is to be notified that the sample's holding time was missed and the customer is to decide if the sample analysis is to continue. The documentation of missed holding time and the client's decision to proceed must be included in the corresponding job file. A statement dictating all holding time occurrences must accompany the sample results in the final report.

16.12 Surrogate Results Do Not Meet Criteria

Poor surrogate recovery should be followed by re-analyzing a smaller aliquot to mitigate any matrix interferences. Evaluate the out of control surrogate for the effect on individual sample results.

17) Contingencies for Handling Out-of-Control or Unacceptable Data

17.1 The following is specific information on how to report unacceptable data. If the data requires a data qualifier flag, as specified in this SOP, refer to Appendix D of the most recent version of the Quality Assurance Manual for the appropriate data qualifier.

17.2 Initial Calibration and/or Initial Calibration Verification

All results reported with an unacceptable ICAL must be reported as estimated and all data shall be reported using defined qualifiers or flags or explained in the case narrative accordingly.

17.3 Continuing Calibration Verification

All results associated with an unacceptable CCV (other than #1 below) must be reported with the appropriate data qualifier, flag and/or explained in the case narrative.

1. When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported without a qualifier.
2. When the acceptance criteria for the continuing calibration verification are exceeded high, i.e., high bias, and there are associated samples with detects, then those detects must be reported with a qualifier, flag and/or explained in the case narrative.
3. If however, the acceptance criteria for the continuing calibration verification are exceeded low, i.e., low bias, and there are associated samples that are non-detects, then those non-detects must be reported with qualifiers, flags and/or explained in the case narrative as having less certainty. However, along with the data qualifiers, the case narrative may include information stating the fact that the results were not significantly affected if:
   a. *An MRL check standard was analyzed and found to be acceptable. The MRL must be the same as that analyzed in the MRL check standard for those analytes that were biased low in the CCV. Adjust MRLs (if required), flag data and state the certainty in the case narrative where the sensitivity of the instrument was demonstrated at the MRL; therefore, results were not significantly affected.*
   b. *With the reporting limit adjusted to the next level in the calibration curve (typically 5 times higher) to prove the nonexistence of a false negative and note procedure in case narrative.*
4. If the acceptance criteria was exceeded (biased high) for the CCV and there were detectable results in a sample, the results may be "qualified" if the results exceeded the regulatory/decision limit (this is to be stated in the case narrative along with the data qualifiers or flags).

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17.4 Method Blank

- If an analyte in the blank is found to be out of control and the analyte is also found in associated samples, those sample results shall be "flagged" in the report and the method blank results reported.
- If the analyte is found in the blank but not in the sample then the results for the sample may be reported without a qualifier.

17.5 Laboratory Control Sample

All results associated with an out of control laboratory control sample must be reported with the appropriate data qualifier. An indication of whether the LCS was out high or low should also be included.

17.6 Surrogate

Report sample results with the appropriate data qualifier.

17.7 Laboratory Duplicate

All batch sample results associated with an out of control laboratory duplicate must be flagged with the appropriate data qualifier.

17.8 Internal Standard

All target analytes associated with an out of control internal standard must be flagged with the appropriate data qualifier.

17.9 Estimated Sample Results

17.9.1 Sample Hold Time All occurrences of missed holding times must be included on the final report including those samples received and/or analyzed outside of the specified hold times detailed in this SOP.

17.9.2 Matrix Interference Sample data associated with matrix interference must be flagged with the appropriate data qualifier.

17.9.3 Results Outside Initial Calibration Range All sample results not bracketed by initial calibration standards (within calibration range) must be reported as having less certainty by reporting with the appropriate data qualifier.

18) Training

18.1 Demonstration of Capability

All analysts must be trained in accordance with the guidelines detailed in the *SOP for Training Policy*. Demonstrations shall also be performed in accordance with the 2009 TNI Standards (Volume 1 Module 4 Section 1.6) and DoD Quality Systems Manual 4.2 (Requirement Box 25). Attachment A shall be used to document the training plan for new analysts' initial demonstration. Additionally, these demonstrations are performed anytime there is a change in instrument type, personnel or method.

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Once performance is found to be acceptable, a required certification statement must be completed by the QA Manager and either the immediate supervisor or Laboratory Manager and retained on file as a demonstration of compliance.

18.1.1 Quarterly Demonstration A demonstration of method sensitivity must be performed *quarterly on each instrument* performing this method.

1) A spike at the current LOD must be analyzed.
2) Verification of precision and bias at the LOQ must be performed.

Refer to Section 11.7.4.2 (LOQ) and 11.17.1 (LOD) for additional information on how these demonstrations are to be performed as well as the acceptance criteria.

18.1.2 Annual Demonstration Each analyst must perform this demonstration both initially and annually. Analyze four LCS standards at 1-4x the MRL (LOQ) either concurrently or over a period of days as a verification of precision and bias of the quantitation range. The standard deviation (n-1) and average percent recovery of the four replicates are compared against the method requirement for precision (±25%) and current laboratory control limits for bias/LCS.

18.1.3 Change in Personnel, Instruments, Method and/or Matrix The requirements in Sections 18.1.1 and 18.1.2 must be performed per the schedule noted and when there is a change in personnel, instruments, method or matrix. "Change" refers to any change in personnel, instrument, test method, or sample matrix that potentially affects the precision and bias, sensitivity, or selectivity of the output (e.g., a change in the detector, column type, matrix, or other components of the sample analytical system, or a method revision).

All completed attempts at this demonstration must be completed and turned into the QA department for retention.

19) Method Modifications

19.1 Method modifications are not allowed under NELAC\TNI standards; therefore, a statement, however worded, must be included in the final report indicating that data reported does not fall under the laboratory's NELAC certificate of approval. In addition, the following items are considered to be method modifications and must be reported accordingly.

- Sample collection in gas collection bags
- The pressurization of canisters with nitrogen or helium (if EPA Method 3C is requested) refer to Section 11.11.

20) Summary of Changes

20.1 SOP updated using ALS SOP Template – New cover page, document tracking/signature page, and table of contents page. Header/footer and font revised throughout SOP to align with ALS SOP template specifications. Sections reorganized as outlined in the *SOP for Establishing Standard Operating Procedures* and section references updated as necessary. Section titled "Instrument Specific Addendum" removed (Section 21.0 in previous revision - "Not Applicable" listed under section).

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Table of Contents	Updated
Section 1	Renamed section heading "Scope and Applicability"
Section 2	Renamed section heading "Summary of Procedure"
Section 4	Was Section 10 in previous revision
Section 5	Was Section 4 in previous revision
Section 6	Was Section 5 in previous revision
Section 7	Was Section 6 in previous revision
Section 8	Was Section 7 in previous revision
Section 8.5	First Bullet – Updated Column
Section 8.6	Added Windows 7
Section 9	Was Section 8 in previous revision
Section 10	Was Section 9 in previous revision
Section 11.1	Updated SOP title
Section 11.5.1	Edited setpoints to reflect current use
Section 11.7	#13 – 4th bullet – Added parentheses in last sentence
	#13 – 5th bullet – Added for clarification
Section 11.10.1	Added second paragraph
Section 11.12.1	Updated "25cc" to "20cc"
Section 11.16.1	Updated both SOP titles
	Removed reference to SOP attachment
Section 13.9.4	Updated file path
Section 16.1	Updated SOP title
Section 18	Was Section 19 in previous revision
	Renamed section heading "Training"
Section 18.1	Updated SOP title
	Updated "QA Program Manager" to "QA Manager"
Section 19	Was Section 20 in previous revision
Section 20	Was Section 22 in previous revision
Table 2	Updated MDL values
	Corrected m-,p-Xylenes CAS Number
Table 2A	Updated MDL values
Table 3	Updated values
Table 3A	Updated values
Table 4	Updated values
Table 4A	Updated values
Attachment A	Removed information at top of checklist covered in SOP header
	#4 – Updated 2nd, 3rd, and 5th SOP titles
Attachment B	Removed MS10 from list of instruments and added MS21
	#13 – Changed "Point" to "calibration level"
Attachment C	Revised Note in Parentheses at top of checklist
	Changed "CAS Project #" to "Project #"
	Removed MS10 from list of instruments and added MS21

21) References

21.1 EPA Method TO-14A, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.

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21.2 EPA Method TO-15, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, EPA/625/R-96/010b, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1997.
21.3 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, January 1999.
21.4 Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Addendum, January 17, 2002.
21.5 National Environmental Laboratory Accreditation Conference, *2003 NELAC Standard*, June 5, 2003, EPA 600/R-04/003 and 2009 TNI Standards.
21.6 *Preparation of Gas Phase Standards for Ambient Air Analysis,* Tekmar-DOHRMANN Application Note, Spring 96, Vol. 6.5.
21.7 *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, 10/25/2010.
21.8 Arizona Administrative Code, Title 9. Health Services, Chapter 14. Department of Health Services Laboratories, December 31, 2006.
21.9 Florida Department of Environmental Protection, Chapter 62-160.
21.10 Minnesota Department of Health, 4740.2065, *Standard Operating Procedures*, Statutory Authority: MS s 144.97; 144.98; History: 31 SR 446, Posted: October 09, 2006, Revised April 16, 2010.

22) Attachments

22.1 Tables

Table 1: Instrument Tune Check Ion Abundance Criteria (TO-15)
Table 1A: Instrument Tune Check Ion Abundance Criteria (TO-14A)
Table 2: Volatile Organic Compounds, EPA Compendium Method TO-15 (SCAN)
Table 2A: Volatile Organic Compounds, EPA Compendium Method TO-15 (SIM)
Table 3: Standard Concentrations (SCAN) (Primary Sources)
Table 3A: Standard Concentrations (SIM) (Primary Sources)
Table 4: Standard Concentrations (SCAN) (Secondary Sources)
Table 4A: Standard Concentrations (SIM) (Secondary Sources)

22.2 Attachments

Attachment A: Training Plan for Analysis of TO-15 by GC/MS
Attachment B: TO-15 by GC/MS Initial Calibration Checklist
Attachment C: TO-15 by GC/MS Analyses Data Review Checklist
Attachment D: State and Project Specific Requirement

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TABLE 1

Required BFB Key Ions and
Ion Abundance Criteria for Method TO-15

Mass	Ion Abundance Criteria[1]
50	8.0 to 40.0 percent of m/e 95
75	30.0 to 66.0 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5.0 to 9.0 Percent of m/e 95
173	Less than 2.0 Percent of m/e 174
174	50.0 to 120.0 Percent of m/e 95
175	4.0 to 9.0 Percent of m/e 174
176	93.0 to 101.0 Percent of m/e 174
177	5.0 to 9.0 Percent of m/e 176

[1] All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

TABLE 1A

Required BFB Key Ions and
Ion Abundance Criteria for Method TO-14A

Mass	Ion Abundance Criteria
50	15 to 40 percent of m/e 95
75	30 to 60 percent of m/e 95
95	Base Peak, 100 Percent Relative Abundance
96	5 to 9 Percent of m/e 95
173	Less than 2 Percent of m/e 174
174	>50 Percent of m/e 95
175	5 to 9 Percent of m/e 174
176	>95 and <101 Percent of m/e 174
177	5 to 9 Percent of m/e 176

Note: The criteria listed in Tables 1 and 1A shall be met or exceeded in order for EPA Compendium Methods TO-15 or TO-14A to be referenced.

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TABLE 2 - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
Bromochloromethane (IS1)	74-97-5	-	-	130	128, 132	-	-	-
Propene	115-07-1	42.08	NA	42	39,41	0.50	0.13	IS1
Dichlorodifluoromethane (CFC 12)[5]	75-71-8	120.9	1.329	85	87, 101, 103	0.50	0.14	IS1
Chloromethane	74-87-3	50.49	0.911	50	52	0.50	0.15	IS1
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	76-14-2	170.9	1.455	135	137	0.50	0.14	IS1
Vinyl Chloride	75-01-4	62.50	0.9106	62	64	0.50	0.15	IS1
1,3-Butadiene	106-99-0	54.09	0.6149	54	39, 53	0.50	0.16	IS1
Bromomethane	74-83-9	94.94	1.6755	94	96	0.50	0.14	IS1
Chloroethane	75-00-3	64.52	0.8902	64	66	0.50	0.14	IS1
Ethanol	64-17-5	46.07	0.7893	45	46	5.0	0.92	IS1
Acetonitrile	75-05-8	41.05	0.7857	41	40	0.50	0.24	IS1
Acrolein	107-02-8	56.06	0.840	56	55	2.0	0.20	IS1
Acetone	67-64-1	58.08	0.7845	58	43	5.0	1.1	IS1
Trichlorofluoromethane	75-69-4	137.4	NA	101	103	0.50	0.13	IS1
Isopropyl Alcohol	67-63-0	60.10	0.7809	45	43	5.0	0.34	IS1
Acrylonitrile	107-13-1	53.06	0.8060	53	52	0.50	0.18	IS1
1,1-Dichloroethene	75-35-4	96.94	1.213	96	61	0.50	0.16	IS1
tert-Butanol	75-65-0	74.12	0.7887	59	57,41,43	1.0	0.29	IS1
Methylene Chloride	75-09-2	84.94	1.3266	84	49	0.50	0.15	IS1
Allyl Chloride	107-05-1	76.53	0.9376	41	76	0.50	0.14	IS1
Trichlorotrifluoroethane	76-13-1	187.38	1.5635	151	101	0.50	0.20	IS1

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TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
Carbon Disulfide	75-15-0	76.14	1.2632	76	78	5.0	0.13	IS1
trans-1,2-Dichloroethene	156-60-5	96.94	1.2565	61	96	0.50	0.15	IS1
1,1-Dichloroethane	75-34-3	98.96	1.1757	63	65	0.50	0.14	IS1
Methyl tert-Butyl Ether	1634-04-4	88.15	0.7402	73	57	0.50	0.14	IS1
Vinyl Acetate	108-05-4	86.09	0.9317	86	43	5.0	0.60	IS1
2-Butanone (MEK)	78-93-3	72.11	0.7999	72	43	5.0	0.20	IS1
cis-1,2-Dichloroethene	156-59-2	96.94	1.2837	61	96	0.50	0.16	IS1
Diisopropyl Ether	108-20-3	102.18	0.7241	87	45,59,43	0.50	0.16	IS1
Ethyl Acetate	141-78-6	88.106	0.9003	61	70	1.0	0.32	IS1
n-Hexane	110-54-3	86.18	0.6548	57	86	0.50	0.16	IS1
Chloroform	67-66-3	119.4	1.4832	83	85	0.50	0.14	IS1
1,2-Dichloroethane-d4(S)	17060-07-0	-	-	65	67	-	-	IS1
Tetrahydrofuran	109-99-9	72.11	0.8892	72	71,42	0.50	0.26	IS1
Ethyl tert-Butyl Ether	637-92-3	102.176	0.7519	87	59,57	0.50	0.15	IS1
1,2-Dichloroethane	107-06-2	98.96	1.2351	62	64	0.50	0.14	IS1
1,4-Difluorobenzene(IS2)	540-36-3	-	-	114	88	-	-	-
1,1,1-Trichloroethane	71-55-6	133.4	1.3390	97	99, 61	0.50	0.14	IS2
Isopropyl acetate	108-21-4	102.13	0.8718	61	87,43	1.0	0.29	IS2
1-Butanol	71-36-3	74.1224	0.8098	56	41	1.0	0.43	IS2
Benzene	71-43-2	78.11	0.8765	78	77	0.50	0.14	IS2
Carbon Tetrachloride	56-23-5	153.8	1.5940	117	119	0.50	0.15	IS2

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TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
Cyclohexane	110-82-7	84.16	0.7739	84	69,56	1.0	0.26	IS2
tert-Amyl Methyl Ether	994-05-8	102.176	0.7703	73	87,55,43	0.50	0.15	IS2
1,2-Dichloropropane	78-87-5	113	1.1560	63	62	0.50	0.14	IS2
Bromodichloromethane	75-27-4	163.8	1.980	83	85	0.50	0.15	IS2
Trichloroethene	79-01-6	131.4	1.4642	130	132	0.50	0.14	IS2
1,4-Dioxane	123-91-1	88.11	1.0337	88	58	0.50	0.14	IS2
Isooctane	540-84-1	114.23	0.6877	57	41	0.50	0.13	IS2
Methyl Methacrylate	80-62-6	100.12	0.944	100	69	1.0	0.26	IS2
n-Heptane	142-82-5	100.2	0.6837	71	57,100	0.50	0.14	IS2
cis-1,3-Dichloropropene	10061-01-5	111	1.224	75	77	0.50	0.13	IS2
4-Methyl-2-Pentanone	108-10-1	100.2	0.7965	58	85	0.50	0.16	IS2
trans-1,3-Dichloropropene	10061-02-6	111	1.217	75	77	0.50	0.13	IS2
1,1,2-Trichloroethane	79-00-5	133.4	1.4397	97	83	0.50	0.13	IS2
Chlorobenzene-d5(IS3)	3114-55-4	-	-	82	117	-	-	-
Toluene-d8(S)	2037-26-5	-	-	98	100	-	-	IS3
Toluene	108-88-3	92.14	0.8669	91	92	0.50	0.14	IS3
2-Hexanone	591-78-6	100.16	0.8113	43	58	0.50	0.19	IS3
Dibromochloromethane	124-48-1	208.3	2.451	129	127	0.50	0.15	IS3
1,2-Dibromoethane	106-93-4	187.9	2.1791	107	109	0.50	0.15	IS3
n-Butyl Acetate	123-86-4	116.16	0.8825	43	56, 73	0.50	0.18	IS3
n-Octane	111-65-9	114.23	0.6986	57	114	0.50	0.14	IS3

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TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
Tetrachloroethene	127-18-4	165.8	1.6227	166	164	0.50	0.12	IS3
Chlorobenzene	108-90-7	112.6	1.1058	112	114	0.50	0.15	IS3
Ethylbenzene	100-41-4	106.2	0.8670	91	106	0.50	0.15	IS3
m-, p-Xylenes	179601-23-1	106.2	0.8642, 0.8611	91	106	1.0	0.29	IS3
Bromoform	75-25-2	252.8	2.899	173	175	0.50	0.16	IS3
Styrene	100-42-5	104.1	0.9060	104	78, 103	0.50	0.15	IS3
o-Xylene	95-47-6	106.2	0.8802	91	106	0.50	0.16	IS3
n-Nonane	111-84-2	128.26	0.7176	43	57, 85	0.50	0.14	IS3
1,1,2,2-Tetrachloroethane	79-34-5	167.9	1.5953	83	85	0.50	0.15	IS3
4-Bromofluorobenzene(S)	460-00-4	-	-	174	176	-	-	IS3
Cumene	98-82-8	120.2	0.8618	105	120	0.50	0.14	IS3
alpha-Pinene	80-56-8	136.24	0.8582	93	77	0.50	0.14	IS3
n-Propylbenzene	103-65-1	120.1938	0.8670	91	120,65	0.50	0.17	IS3
3-Ethyltoluene	620-14-4	120.2	0.8645	105	120	0.50	0.16	IS3
4-Ethyltoluene	622-96-8	120.2	0.8614	105	120	0.50	0.15	IS3
1,3,5-Trimethylbenzene	108-67-8	120.2	0.8652	105	120	0.50	0.15	IS3
alpha-Methylstyrene	98-83-9	118.19	0.9106	118	103,117	0.50	0.21	IS3
2-Ethyltoluene	611-14-3	120.2	0.8807	105	120	0.50	0.15	IS3
1,2,4-Trimethylbenzene	95-63-6	120.2	0.8758	105	120	0.50	0.15	IS3
n-Decane	124-18-5	142.28	0.7300	57	71,85	0.50	0.15	IS3
Benzyl Chloride	100-44-7	126.59	1.1004	91	126	0.50	0.15	IS3

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TABLE 2 (Continued) - VOLATILE ORGANIC COMPOUNDS, EPA COMPENDIUM METHOD TO-15 (SCAN)								
Compound[1]	CAS Number	Molecular Weight	Density	Primary Ion[2]	Secondary Ion(s)[2]	MRL[3] (µg/m³)	MDL[3] (µg/m³)	IS[4]
1,3-Dichlorobenzene	541-73-1	147	1.2884	146	148	0.50	0.14	IS3
1,4-Dichlorobenzene	106-46-7	147	1.2475	146	148	0.50	0.15	IS3
sec-Butylbenzene	135-98-8	134.2206	0.8601	105	134,91	0.50	0.16	IS3
p-Isopropyltoluene	99-87-6	134.2206	0.8573	119	134,91	0.50	0.16	IS3
1,2,3-Trimethylbenzene	526-73-8	120.1938	0.8944	105	120	0.50	0.15	IS3
1,2-Dichlorobenzene	95-50-1	147	1.3059	146	148	0.50	0.16	IS3
d-Limonene	5989-27-5	136.24	0.8402	68	93	0.50	0.17	IS3
1,2,Dibromo-3-Chloropropane	96-12-8	236.33	2.093	157	75, 39	0.50	0.14	IS3
n-Undecane	1120-21-4	156.31	0.7402	57	71, 85	0.50	0.15	IS3
1,2,4-Trichlorobenzene	120-82-1	181.5	1.459	180	182, 184	0.50	0.18	IS3
Naphthalene	91-20-3	128.17	1.0253	128	129	0.50	0.21	IS3
n-Dodecane	112-40-3	170.34	0.7487	57	71,85	0.50	0.21	IS3
Hexachlorobutadiene	87-68-3	260.8	1.556	225	227	0.50	0.14	IS3
Cyclohexanone	108-94-1	98.14	0.9478	55	42, 98	0.50	0.19	IS3
tert-Butylbenzene	98-06-6	134.22	0.867	119	134	0.50	0.16	IS3
n-Butylbenzene	104-51-8	134.22	0.867	91	134	0.50	0.16	IS3

(S) = Surrogate (IS1) = Internal Standard 1 (IS2) = Internal Standard 2 (IS3) = Internal Standard 3
NA = Not Available

Note 1: Additional compounds may be reported as long as the minimum requirements of this document are met. The compounds listed in this table are reported using TO-15 SCAN. The Selected Ion Monitoring (SIM) compounds are a subset of this list and are included in Table 2A.

Note 2: These are suggested primary and secondary ions. However, any ions in the analyte spectra that are sufficient enough in response to reach the desired reporting limit and having a limited amount of interference, is acceptable for both the primary and secondary ion selection. Analyst experience should be utilized in determining appropriate ions.

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Note 3: The laboratory performs three concentration level analyses (SIM, SCAN and Low Level SCAN). The method reporting limit listed is the standard SCAN limit (at or above lowest concentration in the initial calibration curve), but may change with each new initial calibration performed. Therefore, current reporting limits for the three analysis levels, MRLs in ppbv, and those from the Low Level SCAN should be reviewed in the electronic TO-15 Method Manual.

Note 4: The listing of the internal standard by which the compounds are quantitated is for TO-15 SCAN only. SIM compounds (SCAN subset) and their corresponding ions and internal standards are listed in Table 2A.

Note 5: m/e 101 is ~10% or less of m/e 85 (the base peak) and may not be present for low level results. Retention times must be carefully verified.

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Table 2A – Volatile Organic Compounds, EPA Compendium Method TO-15 (SIM)					
Compound	Primary Ion[1]	Secondary Ion[1]	MRL[2] (ug/m3)	MDL[2] (ug/m3)	IS
Dichlorodifluoromethane	85	87	0.025	0.0024	IS1
Chloromethane	52	50	0.025	0.0031	IS1
Vinyl Chloride	62	64	0.025	0.0025	IS1
Bromomethane	94	96	0.025	0.0052	IS1
Chloroethane	64	66	0.025	0.0021	IS1
Acetone*	58	43	0.50	NA	IS1
Freon 11	101	103	0.025	0.0025	IS1
1,1-Dichloroethene	96	98,61	0.025	0.0031	IS1
Methylene Chloride	84	49	0.10	0.0095	IS1
Trichlorotrifluoroethane	151	153	0.025	0.0030	IS1
trans-1,2-Dichloroethene	96	98,61	0.025	0.011	IS1
1,1-Dichloroethane	63	65	0.025	0.0023	IS1
Methyl tert-Butyl Ether*	73	57	0.025	0.0038	IS1
cis-1,2-Dichloroethene	96	98,61	0.025	0.0098	IS1
Chloroform	83	85	0.10	0.0031	IS1
1,2-Dichloroethane	62	64	0.025	0.0087	IS1
1,1,1-Trichloroethane	97	99	0.025	0.0032	IS1
Benzene	78	77	0.075	0.0046	IS1
Carbon Tetrachloride	117	119	0.025	0.0029	IS1
1,2-Dichloropropane	63	62,76	0.025	0.0021	IS2
Bromodichloromethane	83	85	0.025	0.0036	IS2
Trichloroethene	130	132	0.025	0.0058	IS2
1,4-Dioxane*	88	58	0.10	0.0048	IS2
cis-1,3-Dichloropropene	75	77,39	0.025	0.0095	IS2
trans-1,3-Dichloropropene	75	77,39	0.025	0.015	IS2
1,1,2-Trichloroethane	83	97,61	0.10	0.0034	IS2
Toluene	91	92	0.10	0.0031	IS2
1,2-Dibromoethane	107	109	0.025	0.013	IS2
Tetrachloroethene	166	164	0.025	0.0028	IS2
Chlorobenzene	112	114	0.10	0.0066	IS3
Ethylbenzene	91	106	0.10	0.0046	IS3
m-&-p-Xylene	91	106	0.10	0.0097	IS3
o-Xylene	91	106	0.10	0.0044	IS3
1,1,2,2-Tetrachloroethane	83	85	0.025	0.0047	IS3
1,3-Dichlorobenzene	146	148	0.025	0.011	IS3
1,4-Dichlorobenzene	146	148	0.025	0.012	IS3
1,2-Dichlorobenzene	146	148	0.025	0.0087	IS3
1,2,4-Trichlorobenzene	182	184	0.025	0.019	IS3
Naphthalene	128	129	0.10	0.018	IS3
Hexachlorobutadiene*	225	227	0.025	0.0092	IS3

* Reported upon request NA = Not Available
(IS1) = Internal Standard 1 (IS2) = Internal Standard 2 (IS3) = Internal Standard 3

Note 1: These are suggested primary and secondary ions. However, any ions in the analyte spectra that is sufficient enough in response to reach the desired reporting limit and having a limited amount of interference, is acceptable for both the primary and secondary ion selection. Analyst experience should be utilized in determining appropriate ions.

Note 2: The method reporting limit listed is the standard SIM limit (lowest concentration in the initial calibration curve; must be higher than MDL), but may change with each new initial calibration performed. Therefore, current reporting limits should be reviewed. MDLs in ppbV may be reviewed in the electronic TO-15 Method Manual.

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Table 3
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.1ng	0.2ng	0.5ng	1.0ng	5.0ng	25ng	50ng	100ng
Bromochloromethane (IS1)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Propene	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
Dichlorodifluoromethane (CFC 12)	0.102	0.204	0.510	1.02	5.10	25.50	51.0	102
Chloromethane	0.099	0.198	0.495	0.99	4.95	24.75	49.5	99
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
Vinyl Chloride	0.100	0.200	0.500	1.00	5.00	25.00	50.0	100
1,3-Butadiene	0.122	0.244	0.610	1.22	6.10	30.50	61.0	122
Bromomethane	0.100	0.200	0.500	1.00	5.00	25.00	50.0	100
Chloroethane	0.100	0.200	0.500	1.00	5.00	25.00	50.0	100
Ethanol	0.471	0.942	2.355	4.71	23.55	117.75	235.5	471
Acetonitrile	0.112	0.224	0.560	1.12	5.60	28.00	56.0	112
Acrolein	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
Acetone	0.539	1.078	2.695	5.39	26.95	134.75	269.5	539
Trichlorofluoromethane	0.102	0.204	0.510	1.02	5.10	25.50	51.0	102
Isopropyl Alcohol	0.189	0.378	0.945	1.89	9.45	47.25	94.5	189
Acrylonitrile	0.112	0.224	0.560	1.12	5.60	28.00	56.0	112
1,1-Dichloroethene	0.109	0.218	0.545	1.09	5.45	27.25	54.5	109
tert-Butanol	0.209	0.418	1.045	2.09	10.45	52.25	104.5	209
Methylene Chloride	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
Allyl Chloride	0.108	0.216	0.540	1.08	5.40	27.00	54.0	108
Trichlorotrifluoroethane	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
Carbon Disulfide	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
trans-1,2-Dichloroethene	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
1,1-Dichloroethane	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
Methyl tert-Butyl Ether	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Vinyl Acetate	0.492	0.984	2.460	4.92	24.60	123.00	246.0	492
2-Butanone (MEK)	0.110	0.220	0.550	1.10	5.50	27.50	55.0	110
cis-1,2-Dichloroethene	0.108	0.216	0.540	1.08	5.40	27.00	54.0	108
Diisopropyl Ether	0.109	0.218	0.545	1.09	5.45	27.25	54.5	109
Ethyl Acetate	0.214	0.428	1.070	2.14	10.70	53.50	107.0	214
n-Hexane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
Chloroform	0.108	0.216	0.540	1.08	5.40	27.00	54.0	108
1,2-Dichloroethane-d4 (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Tetrahydrofuran	0.109	0.218	0.545	1.09	5.45	27.25	54.5	109
Ethyl tert-Butyl Ether	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
1,2-Dichloroethane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
1,4-Difluorobenzene(IS2)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
1,1,1-Trichloroethane	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
Isopropyl acetate	0.218	0.436	1.090	2.18	10.90	54.50	109.0	218
1-Butanol	0.205	0.410	1.025	2.05	10.25	51.25	102.5	205

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Table 3 - Continued
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.1ng	0.2ng	0.5ng	1.0ng	5.0ng	25ng	50ng	100ng
Benzene	0.110	0.220	0.550	1.10	5.50	27.50	55.0	110
Carbon Tetrachloride	0.110	0.220	0.550	1.10	5.50	27.50	55.0	110
Cyclohexane	0.208	0.416	1.040	2.08	10.40	52.00	104.0	208
tert-Amyl Methyl Ether	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
1,2-Dichloropropane	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
Bromodichloromethane	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Trichloroethene	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
1,4-Dioxane	0.108	0.216	0.540	1.08	5.40	27.00	54.0	108
Isooctane	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
Methyl Methacrylate	0.210	0.420	1.050	2.10	10.50	52.50	105.0	210
n-Heptane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
cis-1,3-Dichloropropene	0.099	0.198	0.495	0.99	4.95	24.75	49.5	99
4-Methyl-2-Pentanone	0.109	0.218	0.545	1.09	5.45	27.25	54.5	109
trans-1,3-Dichloropropene	0.111	0.222	0.555	1.11	5.55	27.75	55.5	111
1,1,2-Trichloroethane	0.102	0.204	0.510	1.02	5.10	25.50	51.0	102
Chlorobenzene-d5 (IS3)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Toluene-d8 (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Toluene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
2-Hexanone	0.120	0.240	0.600	1.20	6.00	30.00	60.0	120
Dibromochloromethane	0.113	0.226	0.565	1.13	5.65	28.25	56.5	113
1,2-Dibromoethane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
n-Butyl Acetate	0.119	0.238	0.595	1.19	5.95	29.75	59.5	119
n-Octane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
Tetrachloroethene	0.096	0.192	0.480	0.96	4.80	24.00	48.0	96
Chlorobenzene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Ethylbenzene	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
m- & p-Xylene	0.204	0.408	1.020	2.04	10.20	51.00	102.0	204
Bromoform	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Styrene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
o-Xylene	0.101	0.202	0.505	1.01	5.05	25.25	50.5	101
n-Nonane	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
1,1,2,2-Tetrachloroethane	0.098	0.196	0.490	0.98	4.90	24.50	49.0	98
4-Bromofluorobenzene (S)	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**	**25.0**
Cumene	0.101	0.202	0.505	1.01	5.05	25.25	50.5	101
alpha-Pinene	0.098	0.196	0.490	0.98	4.90	24.50	49.0	98
n-Propylbenzene	0.101	0.202	0.505	1.01	5.05	25.25	50.5	101
3-Ethyltoluene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
4-Ethyltoluene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
1,3,5-Trimethylbenzene	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
alpha-Methylstyrene	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
2-Ethyltoluene	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
1,2,4-Trimethylbenzene	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105

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Table 3 - Continued
Standard Concentrations (SCAN) (Primary Sources)[1]

Compound Name	0.1ng	0.2ng	0.5ng	1.0ng	5.0ng	25ng	50ng	100ng
n-Decane	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
Benzyl Chloride	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
1,3-Dichlorobenzene	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
1,4-Dichlorobenzene	0.107	0.214	0.535	1.07	5.35	26.75	53.5	107
sec-Butylbenzene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
p-Isopropyltoluene	0.101	0.202	0.505	1.01	5.05	25.25	50.5	101
1,2,3-Trimethylbenzene	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
1,2-Dichlorobenzene	0.104	0.208	0.520	1.04	5.20	26.00	52.0	104
d-Limonene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
1,2-Dibromo-3-Chloropropane	0.105	0.210	0.525	1.05	5.25	26.25	52.5	105
n-Undecane	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
1,2,4-Trichlorobenzene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Naphthalene	0.095	0.190	0.475	0.95	4.75	23.75	47.5	95
n-Dodecane	0.102	0.204	0.510	1.02	5.10	25.50	51.0	102
Hexachlorobutadiene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
Methacrylonitrile	0.103	0.206	0.515	1.03	5.15	25.75	51.5	103
Cyclohexanone	0.096	0.192	0.480	0.96	4.80	24.00	48.0	96
tert-Butylbenzene	0.106	0.212	0.530	1.06	5.30	26.50	53.0	106
n-Butylbenzene	0.110	0.220	0.550	1.10	5.50	27.50	55.0	110

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

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Table 3A - Standard Concentrations (SIM) (Primary Sources)[1]

Compound Name	10pg	25pg	50pg	100pg	500pg	1000pg	2500pg	10,000pg	20,000pg
Freon-12	10.20	25.50	51.00	102.0	510	1020	2550	10200	20400
Chloromethane	9.90	24.75	49.50	99.0	495	990	2475	9900	19800
Vinyl Chloride	10.00	25.00	50.00	100.0	500	1000	2500	10000	20000
Bromomethane	10.00	25.00	50.00	100.0	500	1000	2500	10000	20000
Chloroethane	10.00	25.00	50.00	100.0	500	1000	2500	10000	20000
Acetone*	53.90	134.75	269.50	539.0	2695	5390	13475	53900	107800
Freon-11	10.20	25.50	51.00	102.0	510	1020	2550	10200	20400
1,1-Dichloroethene	10.90	27.25	54.50	109.0	545	1090	2725	10900	21800
Methylene Chloride	10.70	26.75	53.50	107.0	535	1070	2675	10700	21400
Freon-113	10.70	26.75	53.50	107.0	535	1070	2675	10700	21400
trans-1,2-Dichloroethene	10.50	26.25	52.50	105.0	525	1050	2625	10500	21000
1,1-Dichloroethane	10.40	26.00	52.00	104.0	520	1040	2600	10400	20800
Methyl tert-Butyl Ether*	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200
cis-1,2-Dichloroethene	10.80	27.00	54.00	108.0	540	1080	2700	10800	21600
Chloroform	10.80	27.00	54.00	108.0	540	1080	2700	10800	21600
1,2-Dichloroethane	10.50	26.25	52.50	105.0	525	1050	2625	10500	21000
1,1,1-Trichloroethane	10.30	25.75	51.50	103.0	515	1030	2575	10300	20600
Benzene	11.00	27.50	55.00	110.0	550	1100	2750	11000	22000
Carbon Tetrachloride	11.00	27.50	55.00	110.0	550	1100	2750	11000	22000
1,2-Dichloropropane	10.30	25.75	51.50	103.0	515	1030	2575	10300	20600
Trichloroethene	10.30	25.75	51.50	103.0	515	1030	2575	10300	20600
Bromodichloromethane	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200
1,4-Dioxane*	10.80	27.00	54.00	108.0	540	1080	2700	10800	21600
cis-1,3-Dichloropropene	9.90	24.75	49.50	99.0	495	990	2475	9900	19800
trans-1,3-Dichloropropene	11.10	27.75	55.50	111.0	555	1110	2775	11100	22200
1,1,2-Trichloroethane	10.20	25.50	51.00	102.0	510	1020	2550	10200	20400
Toluene	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200
1,2-Dibromoethane	10.50	26.25	52.50	105.0	525	1050	2625	10500	21000
Tetrachloroethene	9.60	24.00	48.00	96.0	480	960	2400	9600	19200
Chlorobenzene	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200
Ethylbenzene	10.40	26.00	52.00	104.0	520	1040	2600	10400	20800
m,p-Xylenes	20.40	51.00	102.00	204.0	1020	2040	5100	20400	40800
o-Xylene	10.10	25.25	50.50	101.0	505	1010	2525	10100	20200
1,1,2,2-Tetrachloroethane	9.80	24.50	49.00	98.0	490	980	2450	9800	19600
1,3-Dichlorobenzene	10.70	26.75	53.50	107.0	535	1070	2675	10700	21400
1,4-Dichlorobenzene	10.70	26.75	53.50	107.0	535	1070	2675	10700	21400
1,2-Dichlorobenzene	10.40	26.00	52.00	104.0	520	1040	2600	10400	20800
1,2-Dibromo-3-chloropropane	10.50	26.25	52.50	105.0	525	1050	2625	10500	21000
1,2,4-Trichlorobenzene	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200
Naphthalene	9.50	23.75	47.50	95.0	475	950	2375	9500	19000
Hexachloro-1,3-butadiene*	10.60	26.50	53.00	106.0	530	1060	2650	10600	21200

*Reported upon request.

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

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Table 4 - Standard Concentrations (SCAN) (Secondary Sources)[1]

Compound Name	25ng	Compound Name	25ng	Compound Name	25ng
Bromochloromethane (IS1)	**25.0**	1,1,1-Trichloroethane	25.50	alpha-Pinene	24.00
Propene	25.50	Isopropyl acetate	55.00	n-Propylbenzene	24.75
Dichlorodifluoromethane (CFC 12)	25.25	1-Butanol	52.25	3-Ethyltoluene	25.50
Chloromethane	24.50	Benzene	26.00	4-Ethyltoluene	25.50
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	25.75	Carbon Tetrachloride	26.50	1,3,5-Trimethylbenzene	26.00
Vinyl Chloride	25.00	Cyclohexane	50.25	alpha-Methylstyrene	25.50
1,3-Butadiene	26.25	tert-Amyl Methyl Ether	25.75	2-Ethyltoluene	25.25
Bromomethane	25.00	1,2-Dichloropropane	25.50	1,2,4-Trimethylbenzene	25.00
Chloroethane	25.25	Bromodichloromethane	25.50	n-Decane	25.00
Ethanol	119.75	Trichloroethene	24.75	Benzyl Chloride	25.75
Acetonitrile	25.25	1,4-Dioxane	25.75	1,3-Dichlorobenzene	25.75
Acrolein	25.50	Isooctane	25.25	1,4-Dichlorobenzene	26.50
Acetone	129.50	Methyl Methacrylate	51.75	sec-Butylbenzene	26.00
Trichlorofluoromethane	26.25	n-Heptane	25.25	p-Isopropyltoluene	24.25
Isopropyl Alcohol	49.50	cis-1,3-Dichloropropene	24.50	1,2,3-Trimethylbenzene	26.00
Acrylonitrile	25.75	4-Methyl-2-Pentanone	26.25	1,2-Dichlorobenzene	25.50
1,1-Dichloroethene	27.25	trans-1,3-Dichloropropene	27.25	d-Limonene	25.75
tert-Butanol	51.75	1,1,2-Trichloroethane	25.25	1,2-Dibromo-3-Chloropropane	25.25
Methylene Chloride	26.50	**Chlorobenzene-d5 (IS3)**	25.0	n-Undecane	25.50
Allyl Chloride	26.75	**Toluene-d8 (S)**	**25.0**	1,2,4-Trichlorobenzene	25.00
Trichlorotrifluoroethane	26.50	Toluene	26.00	Naphthalene	22.25
Carbon Disulfide	26.00	2-Hexanone	28.50	n-Dodecane	22.75
trans-1,2-Dichloroethene	25.25	Dibromochloromethane	27.00	Hexachlorobutadiene	26.00
1,1-Dichloroethane	25.75	1,2-Dibromoethane	26.00	Methacrylonitrile	25.75
Methyl tert-Butyl Ether	25.50	Butyl Acetate	28.50	Cyclohexanone	23.75
Vinyl Acetate	123.50	n-Octane	25.75	tert-Butylbenzene	26.50
2-Butanone (MEK)	26.50	Tetrachloroethene	23.75	n-Butylbenzene	26.50
cis-1,2-Dichloroethene	26.75	Chlorobenzene	26.00		
Diisopropyl Ether	26.50	Ethylbenzene	25.75		
Ethyl Acetate	51.50	m- & p-Xylene	51.50		
n-Hexane	25.75	Bromoform	27.00		
Chloroform	27.75	Styrene	26.00		
1,2-Dichloroethane-d4 (S)	**25.0**	o-Xylene	25.00		
Tetrahydrofuran	26.00	n-Nonane	25.25		
Ethyl tert-Butyl Ether	25.50	1,1,2,2-Tetrachloroethane	24.75		
1,2-Dichloroethane	26.00	**4-Bromofluorobenzene (S)**	**25.0**		
1,4-Difluorobenzene(IS2)	**25.0**	Cumene	24.50		

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

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Table 4A – ICV/LCS Standard Concentrations (SIM) (Secondary Sources)[1]

Compound Name	500pg
Freon-12	505
Chloromethane	490
Vinyl Chloride	500
Bromomethane	500
Chloroethane	505
Acetone*	2590
Freon-11	525
1,1-Dichloroethene	545
Methylene Chloride	530
Freon-113	530
trans-1,2-Dichloroethene	505
1,1-Dichloroethane	515
Methyl tert-Butyl Ether*	510
cis-1,2-Dichloroethene	535
Chloroform	555
1,2-Dichloroethane	520
1,1,1-Trichloroethane	510
Benzene	520
Carbon Tetrachloride	530
1,2-Dichloropropane	510
Trichloroethene	495
Bromodichloromethane	510
1,4-Dioxane*	515
cis-1,3-Dichloropropene	490
trans-1,3-Dichloropropene	545
1,1,2-Trichloroethane	505
Toluene	520
1,2-Dibromoethane	520
Tetrachloroethene	475
Chlorobenzene	520
Ethylbenzene	515
m,p-Xylenes	1030
o-Xylene	500
1,1,2,2-Tetrachloroethane	495
1,3-Dichlorobenzene	515
1,4-Dichlorobenzene	530
1,2-Dichlorobenzene	510
1,2-Dibromo-3-chloropropane	505
1,2,4-Trichlorobenzene	500
Naphthalene	445
Hexachloro-1,3-butadiene*	520

*Report upon request

Note 1: The concentrations detailed in this table may change with each standard purchased or internally prepared. Refer to the appropriate initial calibration file, where necessary for the corresponding concentrations.

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ATTACHMENT A

Training Plan for Analysis of VOCs by GC/MS

Training Plan for Analysis of VOCs by GC/MS

Trainee _____ Trainer _____ Instrument _____ Training Completion Date _____

1. Read SOP *Training Duration* _____ Trainer ___ Trainee ___ Date _____
2. Read Methods TO-14A & TO-15A *Training Duration* _____ Trainer ___ Trainee ___ Date _____
3. Demonstrated understanding of the scientific basis of the analysis Trainer ___ Trainee ___ Date _____
   Whole air sample preconcentration techniques
   Gas chromatography *Training Duration* _____
   Mass spectrometry
4. Demonstrated familiarity with related SOPs Trainer ___ Trainee ___ Date _____
   SOP for Batches and Sequences; Rev. ___
   SOP for Making Entries onto Analytical Records; Rev. ___ *Training Duration* _____
   SOP for Manual Integration Policy; Rev. ____
   SOP for Significant Figures; Rev. ____
   SOP for Nonconformance and Corrective Action; Rev. ____
   SOP for Performing MDL Studies and Establishing Limits of Detection and Quantitation; Rev. ____
   SOP for Cleaning and Certification of Summa Canisters; Rev. ____
5. Observe performance of SOP *Training Duration* _____ Trainer ___ Trainee ___ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant introduction (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)
6. Perform SOP with supervision *Training Duration* _____ Trainer ___ Trainee ___ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant use (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)
7. Independent performance of the SOP *Training Duration* _____ Trainer ___ Trainee ___ Date _____
   ___sample preparation/dilution and sample loading and analysis
   ___analytical sequence setup
   ___standard preparation
   ___BFB tuning evaluation
   ___initial calibration (model, calculations, manual integrations)/initial calibration verification
   ___manual integrations
   ___continuing calibration verification
   ___EnviroQuant proficiency (recognizing saturation and sensitivity issues)
   ___data reduction and reporting including reporting req. for various agencies, autotexts, documentation
   ___canister and bag handling (including leakers)
   ___initial demonstration of competency (4 Laboratory Control Samples)
8. Instrument operation and maintenance Trainer ___ Trainee ___ Date _____
   ___autosampler *Training Duration* _____
   ___GC and capillary column installation *Training Duration* _____
   ___mass spectrometer *Training Duration* _____
   ___data system *Training Duration* _____

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ATTACHMENT B

Initial Calibration Review Checklist

Initial Calibration Review Checklist - EPA Compendium Method TO-15

ICAL Date:_____ ICAL ID:_____ LIMS ICAL ID:_____

Instrument: ☐ MS3 ☐ MS7 ☐ MS8 ☐ MS9 ☐ MS11 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan Scan Low Level (0.1ng): ☐ Yes ☐ No

Analyst **Reviewer**

☐ 1. Is the required documentation in the ICAL file? ..... ☐
- ☐ BFB Tune analysis Report ..... ☐
- ☐ Calibration Status Report (aka Calibration History) ..... ☐
- ☐ Response Factor Report/Percent RSD ..... ☐
- ☐ Quantitation Report for each calibration standard (including manual integration documentation) ..... ☐
- ☐ ICV Quantitation Report ..... ☐
- ☐ TO-15 Standard Calculation Spreadsheet ..... ☐

☐ 2. Was the ICAL performed continuously (not interrupted for maintenance or sample analysis)? ..... ☐

☐ 3. Have all the calibration standards been analyzed within 24 hours of each other? ..... ☐

☐ 4. Does the BFB tune check standard analysis at the start meet the tune criteria? ..... ☐

☐ 5. Are all the analytes in the blank analysis <MRL? ..... ☐

☐ 6. Does each analyte's ICAL include a minimum of 5 concentrations at 5 consecutive levels? ..... ☐

☐ 7. Were the standards analyzed from low concentration to high concentration? ..... ☐

☐ 8. For each analyte, are there no levels skipped? ..... ☐

☐ 9. For each analyte, is there only one value used for each calibration level? ..... ☐

☐ 10. For each analyte, is the lowest standard's concentration at or below the analyte's MRL? ..... ☐

☐ 11. For each analyte, is the corresponding signal to noise ratio at least 3:1 at the lowest point on the curve? ..... ☐

☐ 12. For each analyte, are the corresponding upper levels free from saturation? ..... ☐

☐ 13. If a calibration level is dropped, are all the responses for each target analyte dropped and is the information noted in the ICAL explaining the reason? ..... ☐

☐ 14. Is the average RSD ≤30% for all analytes, with no more than two exceptions ≤40%? ..... ☐

☐ 15. Is the response Y at each calibration level within 40% of the mean area response over the initial calibration range for each internal standard? ..... ☐

☐ 16. Percent recovery for each analyte in the ICV 70%-130% (50-150% for VA, unless AFCEE or DoD)? ..... ☐

☐ 17. Was the RRT for each target compound at each calibration level within 0.06RRT units of the mean RRT for the compound? ..... ☐

☐ 18. Is the retention time shift for each of the internal standards at each calibration level within 20s of the mean retention time over the initial calibration range for each standard? ..... ☐

☐ 19. If there are any manual integrations, are they performed correctly according to the corresponding SOP? If so, initial and date the appropriate pages. ..... ☐

☐ 20. Is the ICAL good at 0.5ng (or 0.1ng) – 100ng (Scan) or 10-20000pg (SIM) for all compounds? ☐ Yes ☐ No
If not, note exceptions and the corresponding MRLs below – *Specify applicable range...* ..... ☐

☐ 21. Are ALL of the peak selections for each analyte correct according to retention time (all RTs must be checked by both the initial and peer reviewer)? ..... ☐

COMMENTS:

Analyst:_____ Date: _____

Secondary Reviewer: _____ Date: _____

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ATTACHMENT C

Data Review Checklist

EPA Compendium Method TO-15 - Data Review Checklist

(Note exceptions in Comments Section and attach Analysis Observations / Case Narrative Summary Form as appropriate)

Method: ☐ EPA TO-15 ☐ EPA TO-14A **Analysis Date:** _____ **Project #:** _____

Instrument: ☐ MS3 ☐ MS7 ☐ MS8 ☐ MS9 ☐ MS11 ☐ MS13 ☐ MS16 ☐ MS19 ☐ MS21

Mode: ☐ SIM ☐ Scan **Scan Low Level (0.1ng):** ☐ Yes ☐ No **DOD:** ☐ Yes ☐ No

Analyst **Reviewer**

☐ 1. Is the required documentation present? ..... ☐
- ☐ CORRECT BFB Tune analysis Report
- ☐ CCV analysis Quantitation Report & %D Report
- ☐ Duplicate analysis Quantitation Report
- ☐ Quantitation Report for each sample included
- ☐ Manual Integration & Q Deletion Documentation
- ☐ LCS analysis Quantitation Report
- ☐ MB analysis Quantitation Report
- ☐ Spectral match details for each hit, where necessary

☐ 2. Does the BFB **tune** check standard analysis meet the tune criteria for the method indicated above? ..... ☐

☐ 3. Are all analyses within the tune's **24-hr window or** ☐ **Client's 12hr window requirement**? ..... ☐

☐ 4. Does the **CCV** have a difference ≤30% for all analytes? ..... ☐
[Note all outliers biased high and/or low]

☐ 5. Are all the **IS** retention times within 20 seconds of the CCV RT or the RT from the midpoint (ICAL)? ..... ☐

☐ 6. Are all the **IS** responses within ±40% of CCV or the midpoint in the ICAL? ..... ☐

☐ 7. Are all the **surrogate** recoveries (in CCVs, MB, LCSs, etc.) within acceptance limits (70%-130%) ..... ☐

☐ 8. Are all the analytes in the **MB** <MRL? (DoD <1/2MRL, except Acetone, MeCl2, EtOH, Carbon Disulfide)? .... ☐

☐ 9. Is the **LCS** %R within the lab control limits for all analytes except AZ samples (70%-130%, VA 50%-150%)? . ☐

☐ 10. Are all the analytes in the **Lab Duplicate / DLCS** within ±25% or the client specified limits? ..... ☐

☐ 11. Are all the analyte hits in the samples within the **calibration range** and/or noted? ..... ☐

☐ 12. Are all **peak integrations** acceptable? ..... ☐

☐ 13. Are all **manual integrations** flagged and documented? ..... ☐

☐ 14. Are ALL of the peak selections for each analyte correct according to **retention time**? ..... ☐

☐ 15. Are all the Q Deletions correct? ..... ☐

☐ 16. Are all **calculations** correct? ..... ☐

☐ 17. Has the analyst initialed and dated each **quantitation report**? ..... ☐

☐ 18. For **TICs** are the relative intensity and other requirements met? ..... ☐

☐ 19. **Auto report** correct? ..... ☐

☐ 20. **MRL** = _____ ☐ ug/m3 ☐ pg (ethanol, acetone, vinyl acetate = 5.0ug/m3) ..... ☐

☐ 21. Pressurized with **Helium**? Is the worksheet completed for all samples? ..... ☐

☐ 22. Report to **MDL**? ☐ Yes ☐ No ..... ☐

☐ 23. **Global Minimum Detection Limit** = _____ ☐ ug/m3 ☐ pg ..... ☐

☐ 24. **DOD:** Are **manual integrations** notated in the **case narrative?** ..... ☐

COMMENTS:

☐ LIMS Run Approval ☐ LIMS Supervisor Approval

Analyst: _____ Secondary Reviewer: _____

Date: _____ Date: _____

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ATTACHMENT D

State and Project Specific Requirements

Minnesota Requirements	
Item	**Criteria**
Holding Time (HT)	14 days
Tedlar bags	Not allowed for sampling or sample dilution
Canisters and flow controllers	Individually certified Individually leak checked before shipment
	Samples with concentrations outside of the calibration curve will have a zero canister analysis performed to check for carryover. If carryover is detected, system bake out shall be performed and documented. Additionally, in instances where the laboratory has evidence on file that a particular compound when present at a high concentration does not exhibit carry-over, the samples will not be reanalyzed. When samples are analyzed that have a higher concentration than the evidence on file, the above requirements must be followed. Also, samples that have hits below the MRL will not be reanalyzed when analyzed after a sample with concentrations over the calibration range.
Method Reporting Verification Check	Analyze a Method Reporting Verification at the beginning of the sequence prior to analyzing samples. Acceptance criteria ±40%.
Duplicates	10 percent laboratory duplicates
Record retention	MN/NELAC 5 years MPCA (Minnesota Pollution Control Agency) compliant samples 10 years
Tier level	TIII

Arizona Requirements	
Item	**Criteria**
LCS	70-130% (vinyl acetate 50-150%)

Department of Toxic Substances Control (DTSC) Requirements	
Item	**Criteria**
Holding Time (HT)	72 hour hold time for canisters

EPA Region 9 Requirements	
Item	**Criteria**
Holding Time (HT)	14 days

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SOP for CO2 and CO Collected in Canisters and Analyzed by USEPA 25C Modified

QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-MS/MS)

ALS-KELSO

SOPID:	LCP-LCMS4	Rev. Number:	2	Effective Date:	11/30/2013

Proprietary

Approved By: _____ Date: 11/14/13
Department Supervisor - Colleen Schroeder

Approved By: _____ Date: 11/15/13
QA Manager - Suzanne LeMay

Approved By: _____ Date: 11/14/13
Laboratory Director - Jeff Grindstaff

Issue Date:	_____	Doc Control ID#:	_____	Issued To:	_____

STANDARD OPERATING PROCEDURE

for

QUANTITATION OF NITROAROMATICS AND NITRAMINES IN WATER, SOIL, AND TISSUE BY LIQUID CHROMATOGRAPHY AND TANDEM MASS SPECTROMETRY (LC-MS/MS)

Proprietary

1. SCOPE AND APPLICATION

1.1. This Standard Operating Procedure (SOP) describes the method used for trace analysis of explosives residues by liquid Chromatography and tandem mass spectrometry. This method describes both the extraction and chromatographic procedures used to determine the target analytes and reporting limits listed in Table 1.

1.2. This procedure is used to determine the analytes of interest in a water, tissue, soils or sediment matrices. The procedure may be applied to other miscellaneous sample matrices providing that the analyst demonstrates the ability of the procedure to give data of acceptable quality in that matrix. The Method Reporting Limits (MRLs) for target analytes in water and soil are presented in Table 1. Method Detection Limits (MDLs) which have been achieved are also given.

2. METHOD SUMMARY

2.1. All of these compounds are either used in the manufacture of explosives or are the degradation products of compounds used for that purpose. When making stock solutions for calibration, treat each explosive compound with caution. This procedure is restricted to use by or under the supervision of analysts experienced in the use of LC-MS/MS, skilled in the interpretation of chromatograms, and experienced in handling explosive materials (see SAFETY section). Each analyst must demonstrate the ability to generate acceptable results with this method.

2.2. This method provides liquid chromatographic tandem mass spectrometry (LC-MS/MS) conditions for the detection of ppb levels of certain explosives residues in water, tissue, soils or sediment matrices. Appropriate sample preparation techniques must be used prior to HPLC analysis.

2.2.1. Aqueous samples are extracted using Solid Phase Extraction (SPE) to clean up and concentrate the sample. This technique is described in EPA Methods 8330A and 3535. With this technique, aqueous samples of low concentration are extracted by passing the sample through a pre-conditioned SPE cartridge. Target analytes are eluted from the SPE cartridge with acetonitrile which is then carefully concentrated. The concentrated extract is then diluted 1:1 with water filtered, and analyzed.

2.2.2. Soil and sediment samples are extracted by sonication in acidified acetonitrile using an ultrasonic bath, filtered, concentrated to 1 ml, diluted 1:1 with 5mM ammonium acetate in deionized water, and analyzed.

2.3. The LC-MS/MS analysis uses a Shimadzu HPLC with an Applied Biosystems API 5000 MS/MS detector or equivalent. Analytes are separated on a Phenomenex Synergi Hydro-RP 250 mm x 4.6 mm 4 µm column.

3. DEFINITIONS

3.1. Analysis Sequence - Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration (initial or continuing verification) followed by sample extracts interspersed with calibration standards (CCBs, CCVs, etc...) The sequence ends when the set of samples has been injected or when qualitative and/or quantitative QC criteria indicate an out-of-control situation.

3.2. Independent Calibration Verification (ICV) - Initial calibration verification standards which are analyzed after initial calibration with newly prepared standards but prior to sample analysis, in order to verify the validity of the standards used in calibration. The ICV standards are either prepared from a materials obtained from a source different from that used to prepare calibration standards, or prepared from the same source by an independent analyst.

3.3. Matrix Spike/Duplicate Matrix Spike (MS/DMS) Analysis - In the matrix spike analysis, predetermined quantities of target analytes are added to a sample matrix prior to sample extraction and analysis. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the method used for the analysis. Samples are split into duplicates, spiked, and analyzed. Percent recoveries are calculated for each of the analytes detected. The relative percent difference (RPD) between the samples is calculated and used to assess analytical precision. The concentration of the spike should be at 5 to 10 times the MRL or at levels specified by a project analysis plan.

3.4. Standard Curve - A standard curve is a calibration curve which plots concentrations of a known analyte standard versus the instrument response to the analyte. Average response factor, linear or quadratic regression models may be used as described in ALS calibration policy and Method 8330. The appropriate criteria for assessing the validity of the calibration curve must be followed prior to quantitation of target analytes in actual sample analyses.

3.5. Surrogate - Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction and chromatography, but which are not normally found in environmental samples. The purpose of the surrogates is to evaluate the preparation and analysis of samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to extraction and analysis. Percent recoveries are calculated for each surrogate.

3.6. Method Blank (MB) - The method blank is an artificial sample composed of analyte-free water or solid matrix (sodium sulfate or sand) and is designed to monitor the introduction of artifacts into the analytical process. The method blank is carried through the entire analytical procedure.

3.7. Continuing Calibration Verification Standard (CCV) - A mid-level standard injected into the instrument at specified intervals. Used to verify that the initial calibration curve is still valid for quantitative purposes.

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3.8. Instrument Blank (CCB) – The instrument blank (also called continuing calibration blank) is a volume of clean solvent analyzed on each column and instrument used for sample analysis. The purpose of the instrument blank is to determine the levels of contamination associated with the instrumental analysis itself, particularly with regard to the carry-over of analytes from standards or highly contaminated samples into subsequent sample analyses.

4. INTERFERENCES

4.1. Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

4.2. Although absolute baseline resolution may not be possible for all target analytes, using the instrument conditions given, the compounds listed in Table 1 have been resolved adequately for quantitation purposes. If coelution and/or matrix interferences are suspected, peak purity and spectral analysis may be used to aid in qualitative evaluation. Degradation products may also present problems by appearing as target analyte peaks. Where this is suspected, spectral confirmation, coupled with peak purity analysis, may prove to be a useful technique in resolving any uncertainties.

4.3. Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All samples expected to contain tetryl should not be exposed to temperatures above room temperature.

5. SAFETY

5.1. All appropriate safety precautions for handling solvents, reagents and samples must be taken when performing this procedure. This includes the use of personal protective equipment, such as, safety glasses, lab coat and the correct gloves.

5.2. Chemicals, reagents and standards must be handled as described in the ALS safety policies, approved methods and in MSDSs where available. Refer to the ALS Environmental, Health and Safety Manual and the appropriate MSDS prior to beginning this method.

5.3. The toxicity or carcinogenicity of each compound or reagent used in this method has not been precisely determined; however, each chemical compound should be treated as a potential health hazard. Exposure to these compounds should be reduced to the lowest possible level. A reference file of material safety data sheets is available to all personnel involved in these analyses. ALS also maintains a file of OSHA regulations regarding the safe handling of the chemicals specified in this method.

5.4. Standard precautionary measures used for handling other organic compounds should be sufficient for the safe handling of the target analytes. However, extra caution should be taken when handling the analytical standard neat material for the explosives themselves, or in rare cases where soil or waste samples are highly contaminated with the explosives. Follow the note for drying the neat materials at ambient temperatures.

5.5. Visual observation of a soil sample is also important when taken from a site expected to contain explosives. Lumps of material that have a chemical appearance should be suspect. Explosives are generally a very finely ground grayish-white material. Chunks of TNT-based explosives that have been exposed to light are generally reddish-brown to orange in color.

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6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Sample Collection

Follow conventional sampling and sample handling procedures as specified for semivolatile organics in EPA SW-846. Appropriate safety procedures should be employed at all times. Water samples should be collected in 1 liter amber bottles. Soil samples are collected in glass jars of the appropriate size. Alternatively, if multi-increment sampling will lead to large sample size, polyethylene bags may be used for collection and storage.

6.2. Sample Preservation and Storage

6.2.1. Water, soil and sediment samples must be iced or refrigerated at 4 ± 2□C from time of collection until extraction. Tissue samples must be frozen at <-10□C until extraction begins. Sample extracts must be stored in the dark at 4 ± 2□C. Amber glassware should be used whenever possible to contain the sample extract during all phases of preparation. Sample extracts should be stored in amber autosampler vials.

6.2.2. Water samples must be extracted within 7 days of sampling. Extracts are stored under refrigeration until analysis and must be analyzed within 40 days of extraction.

6.2.3. Soil samples must be extracted within 14 days of sampling. Extracts are stored under refrigeration until analysis and must be analyzed within 40 days of extraction.

6.2.4. Tissue samples must be extracted within 14 days of sampling. Extracts are stored under refrigeration until analysis and must be analyzed within 40 days of extraction.

7. REAGENTS AND STANDARDS

7.1. Reagents

7.1.1. Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lowering the accuracy of the determination.

7.1.2. Acetonitrile, CH_3CN - HPLC grade.

7.1.3. Methanol, CH_3OH - HPLC grade.

7.1.4. Ammonium acetate, NH_4OAC - LCMS grade

7.1.5. Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in chapter one of SW-846.

7.1.6. Glacial Acetic Acid/Acetonitrile- Prepare a solution by diluting 10mL of glacial acetic acid to 1L with acetonitrile.

7.1.7. Organic-free reagent water - All references to water in this method refer to organic-free reagent water in which no detections above the method reporting limit are observed.

IF THIS SOP IS ACCESSED ELECTRONICALLY, IT IS AN UNCONTROLLED COPY AND WILL NOT BE UPDATED.

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7.2. Standards

7.2.1. Stock standard solutions may be purchased from a number of vendors. All standards purchased from vendors must be traceable to NIST or A2LA certified reference materials. Purchased standards are typically prepared at a concentration of 1000 mg/L, and usually are prepared in acetonitrile or acetonitrile/methanol. The vendor-assigned expiration date is used. Alternatively, a stock standard may be prepared from neat material, with one year expiration.

7.2.2. Calibration standards, at a minimum of five concentration levels, are prepared through a dilution of the appropriate volumes of the stock standard solutions with the 5mM ammonium acetate in deionized water /Acetonitrile solution. The lowest standard must represent a sample concentration at or below the MRL and the other standards bracket the concentration ranges expected in samples (nominal concentrations are 1, 5, 10, 25, 50, 100, and 200 ng/mL). These solutions must be made the day of use.

7.2.3. The ICV intermediate standard is made by appropriate dilution of the stock standard to give a working ICV solution with concentration(s) within the calibration range. The stock standard is diluted with the 5mM ammonium acetate in deionized water /Acetonitrile solution. The ICV is used to check the initial calibration curve. The discard date for this standard is 30 days, and the vial should be recapped after analysis.

7.2.4. The Continuing Calibration Verification (CCV) standard is a mid-level standard used to verify the working calibration curve. CCVs are prepared the same as for calibration standards described above. These should be recapped and stored in the dark after each use. They may be reused for up to 30 days.

7.2.5. Surrogate spiking solution is a 10 ppm stock standard of stable isotope labeled analytes. Samples are spiked prior to extraction at a level equivalent to an extract final volume concentration of 50 ng/mL. The solution may be used for up to six months.

7.2.6. Matrix spiking solutions may be purchased from a number of vendors and spiked at such a level that the concentration in the spiked sample is at five to ten times the Method Reporting Limit (MRL). All target analytes should be included and the recoveries monitored. To prepare the matrix spiking solution, dilute a stock standard solution to the appropriate concentration level. The matrix spike solution may used for up to three months.

7.2.7. Continuing calibration blanks (CCB) are 5mM ammonium acetate in deionized water /acetonitrile.

8. APPARATUS AND EQUIPMENT

8.1. High Performance Liquid Chromatograph (HPLC) system

8.1.1. Analytical system complete with gradient pumping capability, column heater, and data system. Shimadzu HPLC with Applied Biosystems API 5000 MS/MS detector or equivalent.

8.1.2. HPLC Columns (recommended):

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Primary Column: 4 micron Hydro-RP HPLC column, 25 cm x 4.6 mm, (Phenomenex Synergi or equivalent).

8.2. Temperature controlled ultrasonic bath (capable of cooling).

8.3. Vortex mixer.

8.4. Balance capable of measurements of ±0.0001 g.

8.5. Disposable cartridge filters - 0.45 um Teflon filter in both 25 mm diameter and 10 mm diameter.

8.6. Disposable and Pasteur pipettes, appropriate sizes.

8.7. Amber scintillation Vials - 20 mL glass with Teflon-lined caps.

8.8. 16 x 100 mm test tubes for vacuum manifold.

8.9. Waters ® Porapak RDX solid phase extraction (SPE) cartridges, or equivalent.

8.10. Vacuum manifold and pump system for use with SPE cartridges.

9. PREVENTIVE MAINTENANCE

9.1. All maintenance activities are recorded in a maintenance logbook kept for each instrument. Pertinent information (serial numbers, instrument I.D., etc.) must be in the logbook. Maintenance entries should include date, symptom of problem, corrective actions, and description of maintenance, date, and name. The log should contain a reference to return to analytical control.

9.2. HPLC System

9.2.1. Mobile phase - Mobile phase solvents are degassed with an inline vacuum degasser.

9.2.2. The analytical column is back flushed when needed. The main indicators of dirty columns are excessive system pressure and changes to chromatography (poor peak shape and/or retention time shift).

9.2.3. Over time, the column will exhibit poorer overall performance, as contaminated sample matrices are analyzed. The length of time for this to occur will depend on the samples analyzed. When a noticeable decrease in column performance is evident and other maintenance options do not result in improvement, the column should be replaced. This is especially true when evident in conjunction with calibration difficulties.

9.3. MS/MS system

9.3.1. The ion source should be removed following the manufacturers instructions and cleaned when a noticeable decrease in signal is apparent.

9.3.2. The inlet assembly including Q0 should be removed following the manufacturers instructions and cleaned monthly or more often if dirty matrices are analyzed.

9.3.3. The fore pump oil should be changed every six months.

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9.4. The instrument should be recalibrated following major maintenance events such as installation of a new column or non-routine instrument repair.

10. RESPONSIBILITIES

10.1. It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. This demonstration is in accordance with the training program of the laboratory. Final review and sign-off of the data is performed by the department supervisor/manager or designee.

10.2. It is the responsibility or the department supervisor/manager to document analyst training, as described in ADM-TRAIN, *ALS-Kelso Training Procedure*.

11. PROCEDURE

11.1. Aqueous sample Solid Phase Extraction Method

11.1.1. Assemble the manifold/trap/vacuum pump apparatus and load the test tube holder with the appropriate number of test tubes. The test tubes and SPE cartridges should be labeled with the appropriate sample ID information. If the number of samples is less than the maximum for the apparatus, place the SPE cartridges (and test tubes) in non-adjacent locations. This will assist in manipulating each extractor as needed.

11.1.2. Each sample should be allowed to equilibrate to room temperature prior to extraction. The matrix spike and surrogate spiking solutions must also be allowed to warm up to room temperature before using.

11.1.3. The LCS and method blank are prepared by adding deionized water to labeled 1L fleakers. The surrogate spiking solution is added to each sample, and the matrix spiking solution is added to the MS, DMS and LCS samples.

11.1.4. Each SPE cartridge is conditioned prior to introduction of sample. The manifold is set to the "Waste" position (Varian model) to allow the eluant to go to waste. Approximately 15 ml of acetonitrile is passed through each SPE cartridge (at approx. 10 ml/min.) without allowing the cartridge to go to dryness. Follow this by passing approximately 30 mls of deionized water through each cartridge (at approx. 10 ml/min.), again without allowing the cartridge to go to dryness. The water is added to the SPE cartridge as the last 0.5 - 1 mls of acetonitrile is passing through the cartridge. Before the last 1-2 mls of deionized water has passed through the SPE tube, the flow of water through the cartridge is halted by use of a stopcock valve. Proceed with sample introduction.

11.1.5. When the flow of water through the SPE tube is halted, the tube should be refilled to just below the lip of the flange at the top. At this point, 60 mL syringes are fitted onto each SPE tube. Each sample is poured into the appropriate syringe and the stopcock opened to allow flow through the SPE tube. The flow rate through the SPE tube should be adjusted to approximately 10ml/min. Before the top frit in the SPE tube is exposed to air, the sample should begin dripping into the SPE cartridges, where it passes through the sorbent and is lost to waste. Continue filling the syringe until the entire sample, typically 1L, has passed through the SPE tube. It is very important that the sorbent bed never be allowed to go dry before

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the entire sample aliquot is extracted. Channeling and other negative effects may impact the sorbent bed enough so that an incomplete extraction is performed.

Note: If the sample contains considerable solids, the SPE cartridge may plug before the entire sample is passed through. If it appears this will happen, prepare a smaller sample size. If the cartridge plugs, filter as much sample as is reasonably possible and record the amount of sample not extracted. From this, the amount of sample extracted and the correct surrogate amount can be determined. Archive the remaining sample to be extracted and continue with the extracted sample.

11.1.6. Ensure that the waste trap has sufficient size to contain the entire combined volume of the samples being extracted. If not, the extraction can be interrupted to empty the container by turning off the vacuum pump and bleeding the vacuum off. After the vacuum is drawn off, empty the waste, reassemble, and continue.

11.1.7. After the entire aliquot of sample has been drawn through the SPE cartridge, the cartridge is allowed to air dry under vacuum for about 3-5 minutes. Once dry, the stopcock is closed and the tube prepared for extraction with acetonitrile. The manifold top must be rotated from the sample "waste" position to the sample "collect" position (Varian model), and all of the manifold needle exit ports should be aligned over the appropriate test tubes. Each SPE cartridge is then filled with approximately 5 mls of acetonitrile (ACN) and the elution process begun. The stopcocks are adjusted so that the flow of extraction solvent through the system is about 1.0 mls/min. After all the SPE cartridges have been extracted, the flow through the cartridges is carefully increased in order to pull any remaining acetonitrile out of the sorbent bed and into the collection tube. Avoid allowing a volume of air to suddenly pull through the tube.

11.1.8. After each cartridge has been completely eluted, the vacuum is turned off and excess pressure vented from the manifold. Each collection tube now contains approximately 5mL of acetonitrile, in which the target analytes have been collected. Concentrate the sample extracts to a 1.0 mL final volume, depending on the sample volume used, using nitrogen and heat (not to exceed 30° C).

11.1.9. The extract is then diluted with 1.00mL of 5mM ammonium acetate in deionized water and filtered through a 0.2µm Nylon membrane. The extract is placed in a amber auto sampler vial and is ready for analysis.

11.2. Soil and Sediment Samples

11.2.1. Sample Drying

11.2.1.1. Dry the entire soil sample in air at room temperature (or less) to a constant weight, being careful not to expose the samples to direct sunlight.

11.2.1.2. Alternatively, the frozen sample may be freeze dried by following the manufacturer's instructions for operation of the freeze dryer.

11.2.2. Sample Grinding

11.2.2.1. Sample grinding for soil samples from ammunition plants and depot and any other soil not originating from firing ranges.

11.2.2.1.1. Dried samples are ground thoroughly in an acetonitrile rinsed mortal and pestle to pass a 10-mesh sieve.

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11.2.2.2.Sample grinding for soil samples from firing ranges

11.2.2.3.Remove the oversize fraction by passing it through a 10-mesh (2mm) sieve. Weigh both fractions then pulverize the entire <2mm fraction in a ring puck mill or equivalent mechanical grinder. In a ring puck mill samples containing crystalline energetic residues (i.e., TNT, RDX, HMX and their breakdown products) can be adequately pulverized by 5 separate 60 sec grinding cycles. If the sample was ground in more than one portion (grinding bowls have a limited capacity) following this step the entire sample should be combined and thoroughly mixed.

11.2.3. Subsampling

11.2.3.1. A subsample is obtained by spreading out the entire sample on a clean surface so that it is only 1 or 2 cm thick and preferably in a fume hood designed to prevent the spread of dust and possible inhalation or residue losses. Then at least 30 different increments, i.e., portions (~0.3g) should be obtained from randomly chosen locations by sampling the whole profile.

11.2.4. Sample Extraction

11.2.4.1.Place a 10 g subsample of each soil sample in an amber scintillation vial. Add 20 mL of 0.1% glacial acetic acid in acetonitrile. Cap with Teflon-lined cap, vortex swirl for one minute, and place in a cooled ultrasonic bath for 18 hours. Ensure that caps remain secured and that vial labels remain intact.

11.2.4.2.After sonication, allow sample to settle for 30 minutes. If necessary, centrifuge the sample(s) in order to separate the solids from the natant liquid. 2.00mL of extract is then diluted to 20mL with 5mM ammonium acetate, filtered through 0.45µm filter and extracted by solid phase using Waters Oasis HLB PN WAT094226 3cc cartridges.

11.2.4.3. SPE cartridges are conditioned with 6mL of acetonitrile followed by 6mL of deionized water. The sample is then extracted at ~1-2mL/min. The cartridge is vacuum dried for 5-10min.

11.2.4.4.The cartridge is eluted with 1.00mL of acetonitrile and brought to 1.00mL in acetonitrile.

11.2.4.5.The extract is then diluted with 1.00mL of 5mM ammonium acetate in deionized water and filtered through a 0.2µm Nylon membrane. The extract is placed in an amber auto sampler vial and is ready for analysis.

11.3. Tissue Samples

11.3.1. Depending on project specifications, tissue samples may be prepared as whole body, edible meat, or dissected portions. All tissues samples are homogenized prior to freeze drying by chopping, blending or grinding. If the sample is a small dissected portion, it may be freeze dried them homogenized.

11.3.2. The homogenized sample is the freeze dried according to manufacturer's instructions for operation of the freeze dryer.

11.3.3. The dry sample is then homogenized by blending or milling.

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11.3.4. Place a 1.0g subsample of each tissue sample in an amber scintillation vial. Quickly freeze the sample, then placed in the freeze drying apparatus and lyophilize overnight.

11.3.5.. A freeze dried sample volume of 1.0g is weighed into a pre-cleaned amber 20 mL VOA vial. Surrogate and matrix spikes are added. 4.5 mL aliquot of acidified (0.1% v:v glacial acetic acid) acetonitrile, and 0.5 mL aliquot of DI water, is added to the sample and placed in a cooled sonic bath for 18 hours. The sample is then centrifuged at 2000 rpm and all of the extract that can be removed is placed in a disposable culture tube.

11.3.6. Filter 1.5mL of the sample extract through a 0.45µm PTFE Filter. 1.0mL of the filtered extract is then diluted to 10mL with 5mM ammonium acetate and extracted by solid phase using Waters Oasis HLB PN WAT094226 3cc cartridges.

11.3.7. SPE cartridges are conditioned with 6mL of acetonitrile followed by 6mL of deionized water. The sample is then extracted at ~1-2mL/min. The cartridge is vacuum dried for 5-10min.

11.3.8. The cartridge is eluted with 1.00mL of acetonitrile and brought to 1.00mL in acetonitrile.

11.3.9. The extract is then diluted with 1.00mL of DI water in deionized water and filtered through a 0.45µm nylon membrane. The extract is placed in an amber auto sampler vial and is ready for analysis.

11.4. HPLC Analysis

11.4.1. Establish the operating parameters on the instrument. Load the method parameters into the software method file (typically filename Explosives.meth). The recommended chromatographic conditions are shown below:

Column Temperature: 35°C
Injection Volume: 10 uL

Time (min)	Methanol:Acetonitrile (8:2)	5mM Ammonium Acetate	Flow Rate (mL/min)
0.00	50%	50%	600
15.00	65%	50%	600
18.00	65%	35%	600
20.00	70%	30%	600
20.10	50%	50%	600
21.50	50%	50%	600

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11.4.2. Calibration

NOTE: Refer to the ALS SOP for *Calibration of Instruments for Organics Chromatographic Analyses* for general calibration procedures. The calibration procedure(s) and options chosen must follow the ALS protocols. In general, the calibration procedure is as follows:

11.4.2.1. Calibrate the system prior to conducting any analyses. Starting with the standard of lowest concentration, analyze each calibration standard and tabulate response (peak area) versus the concentration in the standard. Fit the calibration points with either a linear or quadratic regression (response vs. concentration). Weighting may be used. The correlation coefficient must be ≤ 0.990.

11.4.2.2. Following initial calibration, analyze an ICV standard. The ICV solution must contain all target analytes. Calculate the concentration using the typical procedure used for quantitation. Calculate the percent difference (%D) from the ICV true value. The acceptance criteria for all analytes are ± 30% D of the expected value, as compared to the initial calibration.

11.4.3. Continuing Calibration Verification

11.4.3.1. The working calibration curve or calibration factor must be verified on each analytical sequence by the analysis of one or more mid-range calibration standards (CCV). A mid-level standard (CCV) must be injected at the start of each sequence and after each set of sample extracts (every 10 samples or every 12 hours, whichever is first) in the analysis sequence.

11.4.3.2. The acceptance criterion for all analytes in the CCV is a within ± 30% D of the expected value, as compared to the initial calibration. Refer to the ALS protocols for organics analyses calibration for CCV evaluation protocols.

11.4.3.3. The retention times of the native and labeled compounds in the verification test must be within ±15 seconds of the respective retention times in the most recent calibration verification standard.

11.4.3.4. If the retention time of any compound is not within the limits specified, the LC is not performing properly. In this event, adjust the LC operation conditions and repeat the verification test or recalibrate, or replace the LC column and either verify or recalibrate.

11.4.4. Method Blank

11.4.4.1. Analyze the method blank extracted with each sample batch immediately following the analysis of the CCV to demonstrate that there is no contamination or carryover from the standard analysis.

11.4.4.2. If any compound of interest is found in the blank at greater than the minimum level or one-third the regulatory compliance limit, whichever is greater; or if any potentially interfering compound is found in the blank above the minimum level for each native compound, analysis of samples must be halted until the sample batch is re-extracted and the extracts re-analyzed, and the blank associated with the sample batch shows no evidence of contamination at these levels. All samples must be associated with an

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uncontaminated method blank before the results for those samples may be reported or used for permitting or regulatory compliance purposes.

11.5. Sample Analysis/Qualitative Determination

11.5.1. Analyze the samples using the chromatographic conditions determined for the acquisition method in SRM mode. SRM mode allows only one parent ion , the $[M-H]^-$ ion in negative mode, through the first quadrupole. In the collision cell (Q2) the parent ion is fragmented. In the third quadrupole (Q3) all ions except the quantitation fragment (product ion) are filtered out. The only ions that are allowed through the instrument are ions that have the same parent mass producing the same product mass during a particular segment of analysis time. This analysis segment is specified for a particular retention time range that corresponds to the retention time of a certified standard. The specific parent, fragment and product ions monitored during this analysis are specified in Table 2.

11.5.2. The signal-to-noise ratio (S/N) at the LC peak maximum for each native compound at its daughter m/z must be greater than or equal to 2.5 for each compound detected in a sample extract.

11.5.3. The retention time of the peak for a native compound must be within ±15 seconds of its RT in the most recent CCV.

11.5.4. Because of compound RT overlap and the potential for interfering substances, it is possible that all of the identification criteria may not be met. If identification is ambiguous, an experienced spectrometrist must determine the presence or absence of the compound.

11.5.5. If the criteria for identification are not met, the compound has not been identified and the result for that compound may not be reported or used for permitting or regulatory compliance purposes. If interferences preclude identification, a new aliquot of sample must be analyzed.

12. QUALITY CONTROL

Note: The analyst should refer to ADM-BATCH and CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

12.1. Initial Precision and Recovery Validation

12.1.1. The precision of the extraction procedure and the HPLC/MS/MS procedure must be validated before analysis of samples begins, or whenever significant changes to the procedures have been made. To do this, four liquid matrix samples are spiked with the appropriate matrix spike solution, extracted and analyzed according to this SOP.

12.1.2. Using results of the set of four analyses, compute the average percent recovery (X) of the concentration of each compound in each extract and the relative standard deviation (RSD) of the concentration for each compound, by isotope dilution for compounds with a labeled analog, and by internal standard for compounds without a labeled analog and for the labeled analogs.

12.1.3. For each native and labeled compound, compare RSD and X with the corresponding limits for initial precision and recovery in Table 3. If RSD and X for all compounds meet the acceptance criteria, system performance is acceptable and

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analysis of blanks and samples may begin. If any individual RSD exceeds the precision limit or any individual X falls outside the range for recovery, system performance is unacceptable for that compound. Correct the problem and repeat the test.

12.2. Method Detection Limits

12.2.1. A method detection limit (MDL) study must be undertaken before analysis of samples can begin. To establish detection limits that are precise and accurate, the analyst must perform the following procedure. Spike a minimum of seven blank matrix water samples with the MDL spiking solution. Follow the extraction and analysis procedures in this SOP to analyze the samples.

12.2.2. Calculate the average concentration found (x) in ng/L, and the standard deviation of the concentrations (s) in ng/L for each analyte. Calculate the MDL for each analyte. Refer to CE-QA011, *Performing Method Detection Limit Studies and Establishing Limits of Detection and Quantification.*

13. DATA REDUCTION AND REPORTING

13.1. Isotope dilution quantitation

13.1.1. By adding a known amount of a labeled compound to every sample prior to extraction, correction for recovery of the native analog of that compound can be made because the native compound and its labeled analog exhibit similar effects upon extraction, concentration, and chromatography. Relative responses (RRs) are used in conjunction with the calibration data to determine the concentration in the final extract, as long as labeled compound spiking levels are constant.

13.1.2. The LC/MS/MS data station uses the Xcaliber software to generate the raw data used to calculate the standards $\overline{RR_x}$ values, the sample amounts, and the spike values. When $\overline{RR_x}$ is used, calculate the extract concentration as follows:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RR_x})}$$

Where: Cex = the concentration in the sample extract (ng/mL);
Respx = the daughter ion peak area of the analytes of interest;
RespISTD = the daughter ion peak area of the associated internal standard;
AmtISTD = the concentration, in ng/mL, of internal standard added
$\overline{RR_x}$ = the average response from the initial calibration.

13.2. Internal standard quantitation and labeled compound recovery

13.2.1. Compute the concentration of each native compound that does not have a labeled analog and each labeled compound using the RF from the calibration data and the following equation:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})}$$

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Where: Cex = the concentration in the sample extract (ng/mL);
Respx = the daughter ion peak area of the analytes of interest;
RespISTD = the daughter ion peak area of the associated internal standard;
AmtISTD = the amount, in ng/mL, of internal standard added
$\overline{RF_x}$ = the average response from the initial calibration.

13.2.2. Using the concentration in the extract determined above, compute the percent recovery of the labeled compounds using the following equation:

%R = X/TV x 100

Where X = Concentration found (ng/ml)
TV = Concentration spiked (ng/ml)

13.2.3. The concentration of a native compound in the aqueous phase of the sample is computed using the concentration of the compound in the extract and the volume of water extracted, as follows:

$$Concentration\ (ng/L) = \frac{(Cex)(Vf)(D)}{(Vs)}$$

Where	Cex	=	Concentration in extract in ng/mL
	Vf	=	Final volume of extract in mL
	D	=	Dilution factor
	Vs	=	Volume of sample extracted, liters

13.3. External standard quantitation and labeled compound recovery

13.3.1. Compute the concentration of each labeled compound using the RF from the calibration data and the following equation:

$$C_{ex} = \frac{(Resp_x)(Amt_{ISTD})}{(Resp_{ISTD})(\overline{RF_x})}$$

Where: Cex = the concentration in the sample extract (ng/mL);
Respx = the daughter ion peak area of the analytes of interest;
RespISTD = the daughter ion peak area of the associated internal standard;
AmtISTD = the amount, in ng/mL, of internal standard added
$\overline{RF_x}$ = the average response from the initial calibration.

13.3.2. Using the concentration in the extract determined above, compute the percent recovery of the labeled compounds using the following equation:

%R = X/TV x 100

Where X = Concentration found (ng/ml)
TV = Concentration spiked (ng/ml)

13.3.3. If the selected ion profile area at the daughter quantitation m/z for any compound exceeds the calibration range of the system, dilute the sample extract by the factor

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required to bring the concentration within the calibration range, adjust the concentration of the labeled injection internal standard to the original concentration in the extract, and analyze an aliquot of the diluted extract. If the compound cannot be measured reliably by isotope dilution, dilute and quantitate by the internal standard method, or re-extract the sample using a smaller portion of the sample.

13.4. Analysis of complex samples

13.4.1. Some samples may contain high levels (>1ug/L) of the compounds of interest, interfering compounds, and/or polymetric materials. The concentration of analytes and/or interferences in some extracts may overload the LC column and/or mass spectrometer.

13.4.2. Analyze a smaller aliquot of the sample when the interferences preclude analysis of the full sample volume.

13.4.3. Signal suppression – Coextracted interferences in the sample may suppress signals for the compounds of interest. To detect signal suppression, the labeled injection internal standard(s) must be monitored in the analysis. If the signal for the labeled injection internal standard is suppressed by more than 50% as compared to the average signal for the labeled injection internal standard in the initial calibration, the samples must be further cleaned up and reanalyzed. If the sample cannot be cleaned up further, the sample or extract must be diluted and reanalyzed.

13.4.4. Sample concentrations are reported when all QC criteria for the analysis has been met. Reported results not meeting QC criteria must be qualified with a standard ALS footnote.

13.5. Data Review

Following primary data interpretation and calculations, all data is reviewed by a secondary analyst. Following generation of the report, the report is also reviewed. Refer to the SOP for *Laboratory Data Review Process* for details.

13.6. Reporting

13.6.1. Reports are generated in the ALS LIMS by compiling the SMO login, sample prep database, instrument date, and client-specified report requirements (when specified). This compilation is then transferred to a file which Excel© uses to generate a report. The forms generated may be ALS standard reports, DOD, or client-specific reports. The compiled data from LIMS is also used to create EDDs.

13.6.2. As an alternative, reports are generated using Excel© templates located in R:\PHC\forms. The analyst should choose the appropriate form and QC pages to correspond to required tier level and deliverables requirements. The detected analytes, surrogate and matrix spikes are then transferred, by hand or electronically, to the templates.

14. TRAINING OUTLINE

14.1. Refer to ADM-TRAIN, *ALS-Kelso Training Procedure* to ensure all training requirements are met.

14.2. This method is restricted to use by, or under the supervision of, analysts experienced in the use of high performance liquid chromatography using mass spectrometers. Analysts

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should also be skilled in the interpretation of liquid chromatograms and mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method.

14.3. Review literature (see references, section 19). Review this SOP. Also review the applicable MSDS for all reagents and standards used. Following these reviews, observe the procedure as performed by an experienced analyst.

14.4. The next training step is to assist in the procedure under the guidance of an experienced analyst. During this period, the analyst is expected to transition from a role of assisting, to performing the procedure with minimal oversight from an experienced analyst.

14.5. Perform initial precision and recovery (IPR) study as described above for water samples. Summaries of the IPR are reviewed and signed by the supervisor. Copies are forwarded to the employee's training file.

14.6. Training and proficiency is documented in accordance with ADM-TRAIN, *ALS-Kelso Training Procedure*.

15 CONTENGENCIES FOR HANDLING OUT-OF-CONTROL OR UNACCEPTABLE DATA

15.1. Refer to the SOP for *Non Conformance and Corrective Action (CE-QA008)* for procedures for corrective action. Personnel at all levels and positions in the laboratory are to be alert to identifying problems and nonconformities when errors, deficiencies, or out-of-control situations are detected.

15.2. Handling out-of-control or unacceptable data

14.1.3. On-the-spot corrective actions that are routinely made by analysts and result in acceptable analyses should be documented as normal operating procedures, and no specific documentation need be made other than notations in laboratory maintenance logbooks, runlogs, for example.

14.1.4. Some examples when documentation of a nonconformity is required using a Nonconformity and Corrective Action Report (NCAR):

- Quality control results outside acceptance limits for accuracy and precision
- Method blanks or continuing calibration blanks (CCBs) with target analytes above acceptable levels
- Sample holding time missed due to laboratory error or operations
- Deviations from SOPs or project requirements
- Laboratory analysis errors impacting sample or QC results
- Miscellaneous laboratory errors (spilled sample, incorrect spiking, etc)
- Sample preservation or handling discrepancies due to laboratory or operations error

16 METHOD PERFORMANCE

16.1. This method was validated through single laboratory studies of accuracy and precision. Refer to the reference method for additional method performance data available.

16.2. The method detection limit (MDL) is established using the procedure described in the SOP for The Determination of Method Detection Limits and Limits of Detection (ADM-MDL).

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Method Reporting Limits are established for this method based on MDL studies and as specified in the ALS Quality Assurance Manual.

17 POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1. It is the laboratory's practice to minimize the amount of solvents, acids, and reagents used to perform this method wherever feasibly possible. Standards are prepared in volumes consistent with methodology and only the amount needed for routine laboratory use is kept on site. The threat to the environment from solvents and/or reagents used in this method can be minimized when recycled or disposed of properly.

17.2. The laboratory will comply with all Federal, State, and local regulations governing waste management, particularly the hazardous waste identification rules and land disposal restrictions as specified in the ALS Environmental Health and Safety Manual.

18 METHOD MODIFICATIONS

18.1. This section is not applicable because this procedure is a laboratory developed method.

19 REFERENCES

19.1. *Solid Phase Extraction,* U.S. EPA, SW-846, Final Update III, Method 3535, Revision 0, December 1996

19.2. *Solid Phase Extraction,* U.S. EPA, SW-846, Draft Update IVB, Method 3535A, Revision 1, November 2000.

19.3. *Standard Operating Procedure for Calibration of Instruments for Organics Chromatographic Analyses,* SOP Code SOC-CAL.

19.4. *Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC),* U.S. EPA, SW-846, Final Update II, Method 8330, Revision 0, September 1994.

19.5. *Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC),* U.S. EPA, SW-846, Draft Update IVA, Method 8330A, Revision 1, January 1998.

20 CHANGES SINCE THE LAST REVISION

20.1. Reforamtted SOP to ALS branding.
20.2. Replaced "CAS" references with "ALS".
20.3. Updated SOP references.
20.4. Sec. 7.1.4: Added ammonium acetate.
20.5. Sec. 717: added reagent water.
20.6. Sec. 11.3: Update tissue prep procedure.

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TABLE 1

TARGET COMPOUNDS, MRLs, and MDLs

Compound Name	Method Detection Limit			Method Reporting Limit		
	Water (µg/L)	Soil (µg/kg)	Tissue* (µg/kg)	Water (µg/L)	Soil (µg/kg)	Tissue (µg/kg)
2,4-Diamino-6-nitrotoluene	tbd	15	26	tbd	50	80
2,6-Diamino-4-nitrotoluene	tbd	4.9	8.1	tbd	20	25
HMX	tbd	2.5	1.3	tbd	10	10
RDX	tbd	1.8	0.60	tbd	10	10
2-Amino-4,6-dinitrotoluene	tbd	0.90	3.7	tbd	10	15
4-Amino-2,6-dinitrotoluene	tbd	1.6	3.1	tbd	10	10
2,4,6-Trinitrotoluene	tbd	1.1	2.1	tbd	10	10
1,3,5-Trinitrobenzene	tbd	2.8	2.1	tbd	10	10
1,3-Dinitrobenzene	tbd	6.2	5.7	tbd	20	30
3,5-Dinitroanaline	tbd	1.2	1.7	tbd	10	10
Tetryl	tbd	2.3	-	tbd	10	-
2,4-Dinitrotoluene	tbd	12	6.9	tbd	30	30
2,6-Dinitrotoluene	tbd	6.9	3.2	tbd	25	10
PETN	tbd	2.0	4.0	tbd	10	30

*Tissue MDLs performed in whole body crab.

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TABLE 2

TARGET COMPOUND TRANSITIONS AND COLLISION ENERGY

Compound Name	Transition Type	Parent Q1 (m/z)	Product Q3 (m/z)	(V)	Collision Energy (v)
2,4 Dinitrophenol [a]	Quantitative	183	123	-20	-27
	Qualitative	183	153	-20	-23
Picramic Acid [a]	Quantitative	198	181	-20	-25
	Qualitative	198	168	-20	-22
2,4-Diamino-6-nitrotoluene [b]	Quantitative	168	77	20	50
	Qualitative	168	121	20	24
2,6-Diamino-4-nitrotoluene [b]	Quantitative	168	77	20	50
	Qualitative	168	121	20	24
HMX [a]	Quantitative	355	46	-20	-50
	Qualitative	355	147	-20	-30
C13-HMX [a]	Quantitative	361	150	-20	-14
	Qualitative	361	46	-20	-45
Picric Acid [a]	Quantitative	228	182	-20	-27
	Qualitative	228	63	-20	-40
RDX [a]	Quantitative	281	46	-20	-10
	Qualitative	281	59	-20	-10
2-Amino-4,6-dinitrotoluene [a]	Quantitative	196	46	-20	-56
	Qualitative	196	136	-20	-23
4-Amino-2,6-dinitrotoluene [a]	Quantitative	196	46	-20	-56
	Qualitative	196	136	-20	-23
2,4,6-Trinitrotoluene [a]	Quantitative	226	46	-20	-55
	Qualitative	227	210	-20	-18
1,3,5-Trinitrobenzene [a]	Quantitative	213	183	-20	-18
	Qualitative	213	63	-20	-30
1,3-Dinitrobenzene [a]	Quantitative	168	138	-20	-20
	Qualitative	168	46	-20	-55
3,5-Dinitroanaline [a]	Quantitative	182	152	-20	-20
	Qualitative	182	46	-20	-50
Tetryl [a]	Quantitative	241	213	-20	-10
	Qualitative	241	196	-20	-15
2,4-Dinitrotoluene [a]	Quantitative	182	152	-20	-25
	Qualitative	181	46	-20	-50
2,6-Dinitrotoluene [a]	Quantitative	182	152	-20	-25
	Qualitative	182	46	-20	-50
PETN [a]	Quantitative	375	62	-20	-20
	Qualitative	375	46	-20	-20
C13-1,3-Dinitrobenzene [a]	Quantitative	174	144	-20	-16
	Qualitative	174	46	-20	-30

[a] APCI negative ionization [b] APCI positive ionization

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FIGURE 1

Chromatogram of Explosives ICAL 25ppb by LC-MS/MS

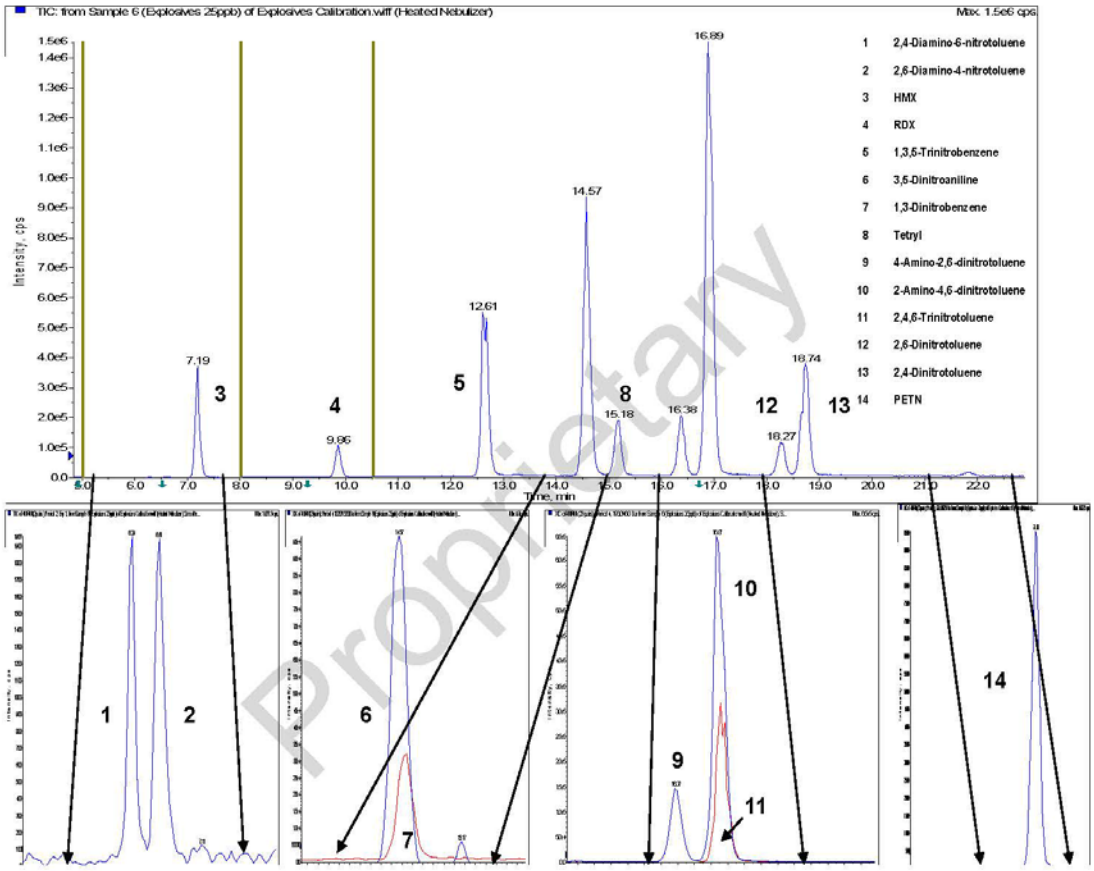

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TABLE 3-1
Target Compounds Control Limits - Waters

Analyte	LCS	%RPD	Matrix Spike	%RPD
2,4-Dinitrophenol	70-130	30	70-130	30
Picramic Acid	70-130	30	70-130	30
2,4-Diamino-6-nitrotoluene	70-130	30	70-130	30
2,6-Diamino-4-nitrotoluene	70-130	30	70-130	30
HMX	70-130	30	70-130	30
Picric Acid	70-130	30	70-130	30
RDX	70-130	30	70-130	30
2-Amino-4,6-dinitrotoluene	70-130	30	70-130	30
4-Amino-2,6-dinitrotoluene	70-130	30	70-130	30
2,4,6-Trinitrotoluene	70-130	30	70-130	30
1,3,5-Trinitrobenzene	70-130	30	70-130	30
1,3-Dinitrobenzene	70-130	30	70-130	30
3,5-Dinitroanaline	70-130	30	70-130	30
Tetryl	70-130	30	70-130	30
2,4-Dinitrotoluene	70-130	30	70-130	30
2,6-Dinitrotoluene	70-130	30	70-130	30
PETN	70-130	30	70-130	30
C13-HMX -Surr	70-130		70-130	
C13-1,3-Dinitrobenz. -Surr	70-130		70-130	

This data is for guidance purposes only until laboratory statistical control limits can be established.

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TABLE 3-2
Target Compounds Control Limits - Soil

Analyte	LCS	%RPD	Matrix Spike	%RPD
2,4-Dinitrophenol	70-130	40	70-130	40
Picramic Acid	70-130	40	70-130	40
2,4-Diamino-6-nitrotoluene	70-130	40	70-130	40
2,6-Diamino-4-nitrotoluene	70-130	40	70-130	40
HMX	70-130	40	70-130	40
Picric Acid	70-130	40	70-130	40
RDX	70-130	40	70-130	40
2-Amino-4,6-dinitrotoluene	70-130	40	70-130	40
4-Amino-2,6-dinitrotoluene	70-130	40	70-130	40
2,4,6-Trinitrotoluene	70-130	40	70-130	40
1,3,5-Trinitrobenzene	70-130	40	70-130	40
1,3-Dinitrobenzene	70-130	40	70-130	40
3,5-Dinitroanaline	70-130	40	70-130	40
Tetryl	70-130	40	70-130	40
2,4-Dinitrotoluene	70-130	40	70-130	40
2,6-Dinitrotoluene	70-130	40	70-130	40
PETN	70-130	40	70-130	40
C13-HMX -Surr	70-130		70-130	
C13-1,3-Dinitrobenzene -Surr	70-130		70-130	

This data is for guidance purposes only until laboratory statistical control limits can be established.

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TABLE 3-3
Target Compounds Control Limits - Tissue

Analyte	LCS	%RPD	Matrix Spike	%RPD
2,4-Dinitrophenol	70-130	40	70-130	40
Picramic Acid	70-130	40	70-130	40
2,4-Diamino-6-nitrotoluene	70-130	40	70-130	40
2,6-Diamino-4-nitrotoluene	70-130	40	70-130	40
HMX	70-130	40	70-130	40
Picric Acid	70-130	40	70-130	40
RDX	70-130	40	70-130	40
2-Amino-4,6-dinitrotoluene	70-130	40	70-130	40
4-Amino-2,6-dinitrotoluene	70-130	40	70-130	40
2,4,6-Trinitrotoluene	70-130	40	70-130	40
1,3,5-Trinitrobenzene	70-130	40	70-130	40
1,3-Dinitrobenzene	70-130	40	70-130	40
3,5-Dinitroanaline	70-130	40	70-130	40
Tetryl	70-130	40	70-130	40
2,4-Dinitrotoluene	70-130	40	70-130	40
2,6-Dinitrotoluene	70-130	40	70-130	40
PETN	70-130	40	70-130	40
C13-HMX -Surr	70-130		70-130	
C13-1,3-Dinitrobenzene -Surr	70-130		70-130	

This data is for guidance purposes only until laboratory statistical control limits can be established.

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Mass and Metals Analysis Sequence

1. Inspect filter.
2. Equilibrate filters for a minimum of 24 hours at correct temperature and humidity
3. Tare weigh filters
4. Equilibrate for another day (20 hours minimum)
5. Perform reweight on 10% of filters
6. Is reweight within 10 µg of initial tare weight? If no, go to 3., if yes continue to 7.
7. Enter tare weight into LIMS
8. Load filter into cassette (if requested)
9. Ship to field
10. Client collects sample on filter
11. Client ships filter back to lab
12. Equilibrate filters for a minimum of 24 hours at correct temperature and humidity
13. Gross weigh filters
14. Equilibrate for another day (20 hours minimum)
15. Perform reweight on 10% of filters
16. Is reweight within 10 µg of initial tare weight? If no, go to 13., if yes continue to 17.
17. Enter gross weight into LIMS
18. Load filters into XRF filter holders
19. Perform XRF analysis, includes replicate on 10% of samples
20. QC check on XRF data
21. Does QC pass? If yes, continue to 20., if no, go to 17.
22. Enter XRF data into LIMS
23. Unload filters from XRF holders
24. Digest filters using modified 3050/IO-3.1 digestion
25. Analyze digestate by ICP
26. QC check on ICP data
27. Does QC pass? If yes, continue to 27., if no, go to 25.
28. Enter ICP data into LIMS
29. Generate report
30. Send report to client

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Appendix P: Raw Data from CEM for CO_2

See the complete set of raw CO2 data collected by the LI-COR Biosciences LI-820 non-dispersive infrared CEM at:

Combined CO2 CEM Raw Data.pdf

Appendix Q: Raw Data from CEM for PM

See the complete set of raw PM data collected by the DustTrak DRX Aerosol Monitor (model #8533) CEM at:

Combined CEM DustTrak Data.pdf